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DOT/FAA/CT-91/20

FAA Technical Center
Atlantic City International Airport
N.J. 08405

General Aviation Aircraft-Normal Acceleration Data Analysis and Collection Project

February 1993

Final Report

This document is available to the public through the National Technical Information Service, Springfield, Virginia 22161

U.S. Department of Transportation
Federal Aviation Administration

NOTICE

Technical Report Documentation Page

1. Report No	2. Government Accession No.	3. Recipient's Catalog No
DOT/FAA/CT-91/20		
4. Title and Subtitle GENERAL AVIATION AIRCRAFT-NORMAL ACCELERATION DATA ANALYSIS AND COLLECTION PROJECT		5. Report Date February 1993 6. Performing Organization Code 2221
7. Author(s) James E. Locke and Howard W. Smith, FRL Edward A. Gabriel ACE-111, and Thomas DeFlore, ACD-220		8. Performing Organization Report No KU-FRL-926-1
9. Performing Organization Name and Address Flight Research Laboratory (FRL) The University of Kansas Flight Research Laboratory 2291 Irving Hill Drive Lawrence, KS 66045-2969		10. Work Unit No (TRAIS) 11. Contract or Grant No
12. Sponsoring Agency Name and Address U.S. Department of Transportation Federal Aviation Administration Technical Center Atlantic City International Airport, NJ 08405		13. Type of Report and Period Covered Final Report 14. Sponsoring Agency Code ACD-220

15. Supplementary Notes

This work was performed as a subcontract to the National Institute for Aviation Research, Wichita State University, Wichita, Kansas 67208. Mr. Dave Ellis was Sub-Task Director.

16. Abstract

This report contains the analysis and condensation of repeated flight loads obtained from 77 airplanes that participated in the NASA VGH General Aviation Program. In addition, the load spectra for 98 airplanes in the NASA VGH data base are presented as plotted and tabulated data. Curve fit equations are listed for the original data and for extrapolation, which was used in the statistical analysis. Airspeed, normal load factor, and altitude were recorded continuously during flight. The load factor data were separated into gust and maneuver normal accelerations. The reduced data are presented as cumulative number of occurrences per nautical mile versus acceleration fraction (incremental normal acceleration divided by incremental limit load factor). For statistical analysis, the airplanes were grouped into seven single and twin-engine operational usage groups. The mean (weighted by flight time); weighted mean plus one, two, and three standard deviation spectra; and the 90% probability/95% confidence spectra were determined for each operational usage group and for several of the groups combined. An estimate of the scatter associated with groups having small sample size was determined by computing a pooled variance and pooled standard deviation. The resulting load spectra are to be used for wing fatigue test or safe-life estimation. The Federal Aviation Administration's plans for further study using the results of this report are discussed. The final objective of this effort is to produce a revised fatigue evaluation report for small and commuter airplane certification under Part 23 of the Federal Aviation Regulations.

17. Key Words		18. Distribution Statement
Flight Load Spectra Fatigue Load Spectra Gust Load Spectra Maneuver Load Spectra	General Aviation Small Airplane Load Factors	Document is available to the public through the National Technical Information Service, Springfield, Virginia, 22161

19. Security Classif. (of this report)	20. Security Classif. (of this page)	21. No. of Pages	22. Price
Unclassified	Unclassified	348	

Form DOT F 1700.7 (8-72) Reproduction of completed page authorized

PREFACE

A work of the kind presented herein cannot be done without the labor of many people. In addition to those cited in the References, Henry Nauert, Aerospace Engineer (Retired), from the FAA Small Airplane Certification Directorate, should be recognized for his important contribution in guiding the work reported in References 3, 10, 11, and 12.

In addition, three University of Kansas students participated:

Greg Miller
Steve Maley
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LIST OF SYMBOLS

Latin

a	normal acceleration
a	slope of the airplane normal force coefficient curve C_{NA} (per radian)
a_n	incremental normal acceleration (normal acceleration -1.0), g units
$a_{n_{LLF}}$	incremental limit load factor (limit load factor - 1.0)
$a_n/a_{n_{LLF}}$	normal acceleration fraction
a_0, a_1, a_2, a_3, a_4	coefficients of the terms in the curve fit equations
g	acceleration due to gravity, 32.2 ft/sec^2
IAS	indicated airspeed, knots
ln	Naperian logarithm
log	common logarithm
m	slope of lift curve, per radian
n	number of airplanes in a group
n	limit load factor
n_g	gust limit load factor
n_m	maneuver limit load factor
S	wing area, ft^2
S	sample standard deviation
S_w	weighted sample standard deviation
SL	sea level
t	"t" statistic
t_i	total flight hours for an individual airplane
T	total flight hours for a group (hrs)

LIST OF SYMBOLS, Concluded

U	gust velocity, ft/sec
V	airplane equivalent airspeed, knots
V_C	design cruising speed
V_D	design dive speed, knots
V_{NE}	never-exceed speed, knots
V_s	stalling speed, knots
W	airplane weight, lb
W/S	wing loading, lb/ft^2
x	acceleration fraction (abscissa)
y	cumulative frequency of exceedance per nautical mile (ordinate)
$\bar{y}$	sample mean
$\bar{y}_w$	weighted sample mean
Z	"z" statistic

Greek

μ	population mean
π	3.1416
ρ	air density, $slugs/ft^3$
ρ_o	air density at sea level, $slugs/ft^3$
σ	population standard deviation
χ^2	chi-squared statistic

Arabic

$1^1, 1^2, 1^3, \ldots$	superscripts indicate additional airplanes of same type involved in different operations

DEFINITIONS AND ACRONYMS

A Basis: At least 99 percent of the population of values is expected to equal or exceed the A basis mechanical property allowable, with a confidence of 95 percent. (Reference 8)

B Basis: At least 90 percent of the population of values is expected to equal or exceed the B basis mechanical property allowable, with a confidence of 95 percent. (Reference 8)

FAA: Federal Aviation Administration

FAR: Federal Aviation Regulations

General Aviation: All civil aviation except scheduled air transport. However, the NASA VGH General Aviation Program included two small airplanes used in commuter airline operations. General aviation airplanes may be of any certification category (e.g., normal, utility, acrobatic, commuter, transport, etc.) or weight class (i.e., small or large airplane).

Part 23: Refers to Part 23 of the Federal Aviation Regulations (FAR) [Reference 9]. This Part contains airworthiness certification standards for normal, utility, acrobatic, and commuter category airplanes.

- <u>Normal, utility, and acrobatic category</u> airplanes have a seating configuration, excluding pilot seats, of nine or less, and have a maximum certificated take-off weight of 12,500 lbs. or less.

- <u>Normal category</u> airplanes are intended for nonacrobatic operation (refer to § 23.3 of Reference 9 for permitted maneuvers).

- <u>Utility category</u> airplanes are designed for limited acrobatic operations (refer to § 23.3 of Reference 9).

- <u>Acrobatic category</u> airplanes are designed for maneuvers without restrictions, other than those shown to be necessary as a result of required flight tests.

- <u>The commuter category</u> is limited to propeller-driven multiengine airplanes having a seating configuration, excluding pilot seats, of 19 or less, and a maximum certificated take-off weight of 19,000 lbs. or less.

Large airplane: An airplane of more than 12,500 lbs. maximum certificated takeoff weight.

Small airplane: An airplane of 12,500 lbs. or less, maximum certificated takeoff weight.

DEFINITIONS AND ACRONYMS, continued

Maximum weight: The highest weight at which compliance with the applicable certification requirements (other than design landing weight requirements) has been shown.

KU-FRL: The University of Kansas Flight Research Laboratory

KU-CRINC: The University of Kansas Center for Research, Inc.

NASA: National Aeronautics and Space Administration

V-G: Velocity, normal acceleration (determined by a recorder installed in an airplane).

VGH: Velocity, normal acceleration, pressure altitude (determined by a recorder installed in an airplane).

Note: Part 1 of the FAR contains additional definitions and abbreviations.

1. INTRODUCTION

1.1 Initiation of NASA Data Collection Program

In 1962, at the request of the Federal Aviation Administration (FAA), and upon recommendation of the National Aeronautics and Space Administration (NASA) Committee on Aircraft Operating Problems, the NASA V-G/VGH General Aviation Program was established. The purpose of the program was to define the gust and maneuver loads, airspeed practices, and altitude usages of general aviation airplanes and to provide a data bank of information for use by airplane designers.

1.2 Recorder Types

The VGH recorder provides a time-history record of the indicated airspeed, pressure altitude, and normal acceleration near the center of gravity of the instrumented airplanes. The V-G recorder provides envelope-type information of the maximum in-flight accelerations and their corresponding airspeeds. Only the VGH data is presented in this report since the V-G data is not applicable to airplane fatigue substantiation. A brief description of the NASA VGH recorder is included in Appendix F.

1.3 Airplane Certification Categories and Types of Operations

FAA's definitions of airplane categories (e.g., normal, utility, acrobatic, commuter) and maximum weight ranges (i.e., small airplane, large airplane) are listed on the page titled Definitions and Acronyms. From October 17, 1979, to September 13, 1983, commuter category airplanes were type certificated to Special Federal Aviation Regulation (SFAR) No. 41, and production was permitted until October 17, 1991. These airplanes were generally derived from small airplane designs that were certificated under Part 23. Amendment 23-34 (effective February 17, 1987) expanded Part 23 to include additional requirements applicable to certification of commuter category airplanes. Some commuter category airplanes have been delivered as normal category small airplanes with executive seating for nine or fewer passengers.

A further clarification of commuter operations may be in order. Small multiengine airplanes, commuter category, and transport category airplanes are being used in commuter airplane operations. FAA's Aging Commuter Airplane Program addresses multiengine airplanes having maximum weights greater than 6,000 lbs., with any seating capacity up to 60 passengers.

To obtain a representative sample of general aviation operations, eight types of operations, as follows, were covered in the NASA data collection program: twin-engine executive, single-engine executive, personal, instructional, commercial survey, aerobatic, aerial application, and commuter airline. These operations are described further in Appendix B.

Care was taken in selecting airplanes in a particular operation to insure that the home bases were located throughout the continental United States. By selectively taking the data from different geographical locations, biasing of the data

because of similar topography was eliminated. Generally, for each recorder installation, an attempt was made to collect data over at least four seasons.

1.4 FAA Program

In 1973, FAA published Report No. AFS-120-73-2, "Fatigue Evaluation of Wing and Associated Structure on Small Airplanes" (Reference 1). The flight load spectra in that report was based on the VGH recorder data available at that time from the NASA VGH General Aviation Program. The data was collected on 36 airplanes flying approximately 12,400 hours. Data collection continued until 1981, at which time 42,155 hours of VGH data were accumulated on 105 airplanes. NASA evaluated the data for 95 airplanes flying 35,286 hours and presented it in tabular form in Reference 2. In 1984, the FAA Small Airplane Directorate contracted with the University of Kansas Center for Research (KU-CRINC) to process approximately 7,000 hours of data that had not been reduced by NASA, and to combine it with the data base published by NASA in Reference 2. The work done by KU-CRINC was completed in July 1986, and the results published in Reference 3.

The history of this program is diagrammed in Figure 1-1. NASA involvement ended with the publication of Reference 4. This report contains histograms which show the distribution of (and average) airspeed, altitude, and flight duration of the individual airplanes in the NASA VGH General Aviation Program. These aspects of this program will not be analyzed further by FAA, and the reader is directed to Reference 4 for detailed information on airspeed, altitude, and flight duration practices.

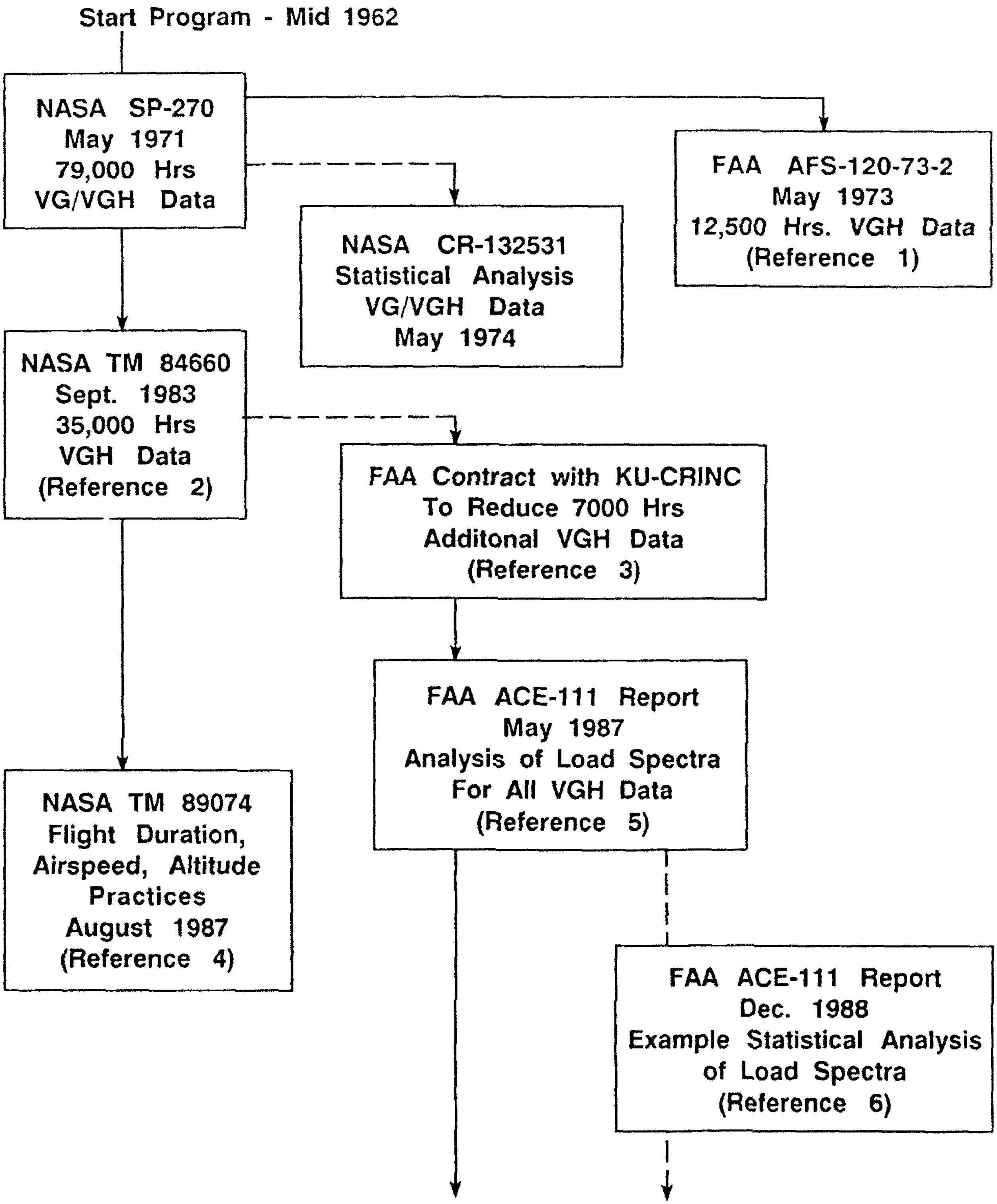
1.5 FAA/Industry Working Group

The Part 23 Airplane Fatigue Working Group was established in 1987, with members from FAA and the small/commuter airplane industry. The initial task of this Working Group is to assist the Small Airplane Directorate in developing updated fatigue substantiation guidance material with load spectra based on the complete VGH General Aviation Data Base. The Working Group first met in August 1987, to develop a plan to complete this task and to review Reference 5 which presented load spectra plots for the complete VGH General Aviation data base (105 airplanes, 42,155 flight hours). The load spectra in Reference 5 were grouped according to airplane operational usage (e.g., single-engine general usage) and compared with the original load spectra in Reference 1. One of the Working Group's recommendations was that the Small Airplane Directorate proceed to investigate the application of statistical analysis for determining and presenting load spectra in probabalistic terms for each airplane operational usage group.

In accordance with the Working Group's recommendation, the Small Airplane Directorate performed an example statistical analysis of the positive maneuver load spectra for the single-engine basic flight instruction group, consisting of ten airplanes. This study was reported in Reference 6. The Working Group met on February 15, 1990, to discuss the results of this study and to decide the course for proceeding further. The discussion of the meeting and agreements

FIGURE 1-1

FAA-NASA VGH GENERAL AVIATION PROGRAM



Continued on Figure 1-2

reached are reported in Reference 7. Regarding the NASA VGH General Aviation Data Base, the Working Group agreed that the determination of the fatigue load spectra, which will be included in a report that will supersede Reference 1, will be done by statistical analysis. Specifically, it was agreed that for the next phase of this program, the load spectra for the operational usage groups shown in Table 1-1 will be determined for the mean plus 1 and the mean plus 2 standard deviations, and for the 90% probability/95% confidence level. The latter corresponds to the statistical definition of the "B basis" mechanical property strength allowable in Reference 8. Considering that fatigue life prediction is not an exact science, the Working Group selected the "B basis" rather than the more stringent "A basis" (99% probability/95% confidence level). Refer to the List of Definitions for definition of "A basis" and "B basis". This agreement led to a contract with the University of Kansas Center for Research, Inc., to complete the final phase of this research effort; i.e., probabalistic load spectra development. The results of this effort are presented in this report.

1.6 Future Work and Application of Results of This Report

The plan for continuing this work to produce a revised fatigue evaluation report for Part 23 airplane certification is diagrammed in Figure 1-2. The effect on airplane fatigue life using the load spectra determined in this report, by statistical analysis, needs to be studied using the method of analysis in Reference 1.

A scatter factor is applied to the life determined by analysis or test to assure that an extremely low probability of failure will be realized during the operational life of the airplanes produced to the type design. The scatter factor is intended to account for service load variability, environmental effects, and fatigue test result variability, which in turn is influenced by such factors as material variability, detail design, quality of construction, loading sequence, etc. The service load variability will be better accounted for by using the load spectra determined by statistical analysis and possible reduction of the scatter factor will be studied.

TABLE 1-1

OPERATIONAL USAGE GROUPS

		Airplanes (Spectra)	Flight Hours
	SINGLE ENGINE		
1.	General Usage		
	a. *Basic Flight Instruction* (Severe Maneuver Spectra)	10	5,470
*	b. Business/Personal: Includes executive transport, charter, cargo, pleasure, instruction, fish spotting	23	5,956
*2.	Special Usage: Pipeline patrol, forest fire patrol, forest fire fighting	4	3,631
3.	Aerial Application	28	7,904
4.	Acrobatic	1	117
	TWIN-ENGINE		
5.	General Usage: Business, charter, cargo, commuter *airlines, flight instruction,* check flights, ambulance, sales demonstration	10	10,522
*6.	Special Usage: Pipeline patrol, forest fire fighting lead plane	3	1,281
7.	Business Jet, General Usage	2	1,986
	SINGLE AND TWIN-ENGINE		
8.	Pressurized, General Usage	4	2,662

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*Note: 1) Groups 1a and 1b will be combined for gust spectra.
2) Load spectra will be determined for groups 2 and 6 both singly and combined.

FIGURE 1-2

FAA PART 23 FATIGUE PROGRAM
(CONTINUED FROM FIGURE 1-1)

REVISION OF REPORT FOR FATIGUE EVALUATION OF WING AND ASSOCIATED STRUCTURE, AFS-120-73-2 REPORT

WORKING GROUP
MEETING, Feb. 15, 1990
ACE-111 Report
Jan.7, 1991
(Reference 7)

FAA CONTRACT WITH KU-CRINC
Statistical Analysis
of Load Spectra
March 1991 - Dec 1992

FATIGUE LIFE STUDY
Comparison of Original and New
Load Spectra and Scatter Factor Variation

WORKING GROUP MEETING

DRAFT OF REVISED WING FATIGUE
EVAULATION REPORT

Final Coordination of Report
with Working Group

PUBLICATION OF REVISED WING
FATIGUE EVALUATION REPORT

2. DISCUSSION

2.1 Identification of Airplanes in Operational Usage Groups

For purposes of performing statistical analysis, the operational usage groups are as shown in Table 2-1. This grouping is essentially the same as shown in Table 1-1 with minor changes and deletions as discussed in the next section. The data was read from Reference 3. The physical characteristics of the individual airplanes in each group are listed in the Tables in Appendix A. A description of the airplane use, operator category, average operating altitude, and geographical location of the airplanes' home bases is contained in Appendix B. The instrumented airplane's home bases were located in various parts of the United States, thus providing for operations over varied terrain and meteorological conditions.

2.2 Rationale for Selection of Airplanes in Operational Usage Groups

a. Airplanes not included

Only airplanes covered by Part 23 of the FAR (Reference 9) were included. The following large airplanes which have maximum weights ranging from 26,300 to 126,000 pounds, were not included: Twin-Engine Executive, No. 1; Commercial Survey airplanes used in forest fire fighting, Nos. 19, 20, 21, 22, 23, and 24. There are only two business jet airplanes, Nos. 2 and 2A; and only one aerobatic airplane, No. 38. Statistical analysis was not performed on these airplanes. The characteristics of these airplanes are listed in Tables A-9, A-10, and A-11.

b. Single-Engine Business/Personal Sub-group

(1) An overlay of the gust load spectra for airplanes in the Executive class and the Personal class showed that the spectra cover approximately the same data range. The same comparison was shown for the maneuver load spectra; therefore, these classes were grouped together in the Business/Personal sub-group of the Single-Engine General Usage Group.

(2) Inclusion of Fish Spotting Airplane (No. 28) in the Business/Personal sub-group. This airplane is included in the Commercial Survey Group in References 2, 3 and 4. It is very similar (identical in maximum weight, horsepower, and wingspan) to airplane No. 18 in the Instructional Group (Table A-1, Appendix A). These airplanes are low-powered light airplanes in the personal/training class.

The gust and maneuver load spectra is the least severe of all the data. Except for negative maneuver, the No. 28 spectra plots well below the spectra for the four airplanes in the Single-Engine Commercial Survey Group. If the No. 28 spectra were included in this group, it would greatly increase the dispersion of the data. For determining final load spectra by statistical analysis, it would be best to

TABLE 2-1

IDENTIFICATION OF AIRPLANES IN OPERATIONAL USAGE GROUPS

SINGLE ENGINE

1. General Usage

   a. Basic Flight Instruction - 10 airplanes:
   Appendix D*: All airplanes except No. 4A (twin-engine).

   b. Business/Personal - 24 airplanes:
   Appendix B*: All airplanes (11) (Executive class).
   Appendix C*: All airplanes (11) (Personal class).
   Appendix E*: Airplane No. 28 only (personal/training type airplane used in fish spotting).
   Appendix I*: One float plane, No. 41.

2. Special Usage - 4 airplanes:
Appendix E*: Airplane 6A, 9B, 17[1] and 27 only.

3. Aerial Application - 25 airplanes:
Appendix F*: All those listed except No. 32[1]; also for No. 33A[2], do not use negative maneuver data less than 3.7×10^{-3} frequency of exceedance.

TWIN-ENGINE

4. General Usage - 8 airplanes:
Appendix A*: Airplanes Nos. 4, 5, and 5[1] only
Appendix D*: Airplane No. 4A only
Appendix H*: Airplane Nos. 39 and 40
Ref. 11: Airplane 310-110 (Instruction operations)
Ref. 12 (pages D.23 to D.29): Airplane No. 255-203

5. Special Usage - 3 airplanes:
Appendix E*: Airplane Nos. 4[1], 25, and 26 only

SINGLE AND TWIN-ENGINE

6. Pressurized General Usage - 3 airplanes:
Appendix A*: Airplane Nos. 3 and 3[1] only
Appendix B*: Airplane No. 6 only

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* Appendices in Reference 3

minimize the dispersion of the data. Therefore, the No. 28 spectra is included in the Single-Engine General Usage, Business/Personal sub-group.

(3) Inclusion of floatplane (No. 41) in the Business/Personal sub-group. This airplane was operated by a fixed-base operator in personnel and cargo charter (bush-type operations). The Single-Engine Executive sub-group includes personnel and cargo charter operations by a fixed-base operator. An overlay of the No. 41 spectra on the Business/Personal sub-group spectra shows that No. 41 fits in well in this sub-group.

c. <u>Single-Engine Special Usage Group</u>

There are only four single-engine airplanes in the Special Usage Group. Their characteristics are listed in Table A-4, Appendix A. Airplane Nos. 6A and 17[1] were used in pipeline patrol over level and mountainous terrain; 9B was used in scouting for forest fires and transporting cargo and personnel in forest fire fighting operations; No. 27 was used in forest fire fighting as lead plane for retardant bombers. The lead planes check for excessive turbulence and mark the drop site.

d. <u>Aerial Application Group</u>

The characteristics of these airplanes are listed in Table A-5, Appendix A. The airplanes in this group were used to disperse chemicals for control of herbs, pests, and insects on farmlands. One was used to disperse chemicals for control of herbs and insects on lakes and streams. The data from several of the airplanes in References 3 and 10 were not used for the following reasons:

(1) Airplane 32[1] was an unusually severe operation treating very short fields. This operation is considered to be unlike typical aerial application operations and, therefore, is not used. The severity of this data is seen in Figures 8A and 9 in Reference 5.

(2) The negative maneuver load spectrum for airplane 33A[2] diverges sharply below 3.7×10^{-3} frequency of exceedance and, therefore, data below this value was not used (page F.71 in Reference 3 and Figure 9 in Reference 5).

(3) Airplane 555-306 was an unusual and very severe operation in Australia. Phosphate loads were salvoed on very short flights having a duration as little as 2.5 minutes. This was done in windy, gusty weather with no concern for drifting dust. The load spectra for this airplane is plotted in Figures 8A and 9 in Reference 5, and also in Reference 10. Data was collected for only 51 flight hours. This operation is considered to be unlike typical aerial application operations and, therefore, was not used.

(4) The gust data for airplane 190-396 is suspect and was not used. It is plotted in Figure 8A of Reference 5. It is believed that the acceleration trace was underdamped, or the accelerometer was mounted on a non-rigid surface.

e. Twin-Engine General Usage Group

The characteristics of these airplanes are listed in Table A-6 of Appendix A.

(1) Piston engine powered airplanes 4, 5, and 5^1 are from the Twin-Engine Executive Group in References 2 and 4. Airplanes 5 and 5^1 are the same type and model. The superscript denotes different operators, operations, or geographical areas.

(2) Airplanes 3 and 3^1 were included in the Twin-Engine General Usage Group in Table 1-1 and in Reference 5. These airplanes have been deleted from this group because their average pressure altitudes flown were 11,143 feet and 9,914 feet, respectively (as reported in Reference 2). These airplanes are included in the Pressurized General Usage Group. The airplanes in the Twin-Engine General Usage Group had an average pressure altitude flown below 5,000 feet, except airplane No. 5, which was 7,400 feet.

(3) Airplanes 39 and 40 were used in commuter airline operations. Average pressure altitudes were below 5,000 feet. Average flight durations were 17 minutes and 31 minutes, respectively. Ninety-five percent of the flights were less than one hour in duration (Reference 4).

(4) Airplane No. 310-110 (data in Reference 11) does not have a NASA published designation and is the same model as No. 4A. These airplanes were used in flight instruction, including instrument flying instruction.

(5) The data for airplane No. 255-203, which was used in executive operations, was obtained from Reference 12. This airplane is the same type as airplane No. 3.

f. Twin-Engine Special Usage Group

The characteristics of these airplanes are listed in Table A-7, Appendix A. There are only three twin-engine small airplanes in the Commercial Survey category in References 2 and 4. Airplanes 4^1 and 25 were used in forest fire fighting as lead planes for retardant bombers. The lead planes check for excessive turbulence and mark the drop site. Airplane 26 was used for pipeline patrol over level and mountainous terrain.

g. Pressurized General Usage Group

The characteristics of these airplanes are listed in Table A-8, Appendix A. There are only three airplanes in this group. Airplanes 3 and 3^1 are twin-engine executive turboprops. Airplane No. 6 is a single (reciprocating) engine airplane. Airplane 255-203 was included in this group in Table 1-1 and in Reference 5. This airplane was deleted from this group because the average altitude flown is estimated at 6,000 feet. This airplane is included in the Twin-Engine General Usage Group. Average pressure altitudes flown are as follows:

Airplane No. 3	11,143 feet
Airplane No. 3[1]	9,914 feet
Airplane No. 6	11,400 feet

2.3 Data Presentation

The data is plotted (and tabulated) as cumulative number of occurrences of normal accelerations per nautical mile versus acceleration fraction for gusts and for maneuvers. The acceleration fraction ($a_n/a_{n_{LLF}}$) is the recorded incremental normal limit load factor (airplane limit load factor minus 1.0 g). The airplane limit load factor was determined from the airplane manufacturer, or in some cases was calculated from the appropriate certification regulation. Only accelerations equal to or greater than $\pm$ 0.4 g (measured from a 1.0 g base) were counted in the data read by KU-CRINC. This was also generally the case for data read by NASA. An exception to this rule was that normal accelerations for airplanes with maximum weight greater than 13,000 pounds (read by NASA and reported in Reference 2) were read to a threshold of $\pm$ 0.3 g. Further exceptions to the NASA read data are as follows: large airplanes Nos. 1, 1[1], 1[2], 1[3], 21, and small airplane No. 28 (used in fish spotting), normal accelerations were read to a threshold of $\pm$ 0.2 g.

It has been common to present flight fatigue loads data as cumulative frequency of exceedance curves with normal acceleration (n_z), incremental normal acceleration (n_z – 1.0), or derived gust velocity (U_{de}) on the abscissa and cumulative frequency per hour, or per thousand hours, etc., on the ordinate. In the safe-life fatigue analysis method in Reference 1, the fatigue load spectra are presented as cumulative frequency of exceedance per nautical mile versus acceleration fraction. This method of presentation is used in this report to maintain consistency with the method of analysis in Reference 1 that has been in use for many years, and because this method helps reduce the data spread inherent in general aviation airplanes of various designs (see Appendix A) being flown in varied operations by a variety of operators (see Appendix B). Reducing the data collected on a particular airplane to occurrences per nautical mile flown, rather than occurrences per hour, reduces the data spread due to the wide range of operating speeds in a particular usage group. To illustrate, this spread is approximately a factor of two for the airplanes in the Single-Engine General Usage Group which have design cruise speeds (V_c) ranging from 87 to 165 knots.

The acceleration fraction, $a_n/a_{n_{LLF}}$, relates the recorded gust accelerations to the airplane's limit gust load factor and relates the recorded maneuver accelerations to the airplane's limit maneuver load factor. When the acceleration fraction is zero, the airplane is in 1.0 g flight. An acceleration fraction of 1.0 on a gust exceedance plot indicates that limit gust load factor has been reached, and on a maneuver exceedance plot indicates that limit maneuver load factor has been reached. Expressing the recorded normal acceleration as an acceleration fraction helps reduce the data spread for airplanes of differing design load factors.

If the limit load factors were not available from the airplane manufacturer, they were calculated by the equations in Section 23.341 of the FAR prior to Amendment 23-7 (effective September 14, 1969). Those that were calculated are noted in the tables in Appendix A. The pre-amendment 23-7 equation for the incremental gust limit load factor is as follows:

$$a_{nLLF} = \frac{30\ K\ V\ m}{498\ W/S} \tag{2.1}$$

where K = $1/2(W/S)^{1/4}$ for W/S>16 psf

K = $1.33 - \dfrac{2.67}{(W/S)^{3/4}}$ for W/S>16 psf

W/S = wing loading at maximum weight, lb/ft^2

V = airplane design cruise speed (V_c), knots EAS

m = wing lift curve slope, C_L per radian, corrected for aspect ratio

A = wing aspect ratio

Notes:

1. 30: Nominal gust velocity in feet per second.

2. $498 = \dfrac{1}{\frac{\rho_o}{2}(1.689)}$

3. m may be determined approximately as $\dfrac{6A}{2+A}$ per radian.

A gust acceleration fraction spectrum for a particular airplane in Appendix C may be converted to a derived gust velocity spectrum by the following procedure:

1. Obtain the gust limit load factor ($\pm\ n_g$) from the airplane characteristics tables in Appendix A.
2. Determine the incremental gust limit load factor (±) from:

   $a_{nLLF} = n_g - 1.$

3. Develop an incremental gust acceleration (a_n) spectrum by multiplying each gust acceleration fraction (a_n/a_{nLLF}) value by a_{nLLF}.

4. Determine derived gust velocity values from the above equation rearranged:

$$U_{de} = \frac{498\ a_n\ (W/S)}{K\ V\ m} = \text{ft/sec, equivalent velocity} \qquad (2.2)$$

It should be noted that the statistically derived gust acceleration fraction spectra in Section 2.5 may not be accurately converted to derived gust velocity spectra using the above procedure since they are determined from data collected on airplanes of various wing loadings, wing aspect ratios, and design cruise speeds. If it is desired to make such a conversion, the derived gust acceleration for each airplane in a group of airplanes of interest would have to be determined by the procedure described above, and then the representative spectra could be determined using the statistical methods employed in this report.

It should be mentioned here that from Amendment 23-7 to the present time, Part 23 of the FAR uses a revised gust load formula (see Section 23.341 of Reference 9). The revised formula is considered to provide a more appropriate basis for gust load calculation. The formula is essentially as stated above except as follows: The gust alleviation factor (K) is calculated on the basis of a one-minus-cosine gust shape and is a function of the airplane mass divided by the mass of a cylinder of air about the wing, whereas K in equations 2.1 and 2.2 is based on a ramp gust shape and is only a function of wing loading. Also, the wing lift curve slope is replaced by the slope of the airplane normal force coefficient curve. The work on the development of these gust load formulas is reported in Reference 13. Gust load fundamentals and the history of the FAR gust load requirements are also discussed in Reference 14.

2.4 Extrapolation of Exceedance Spectra

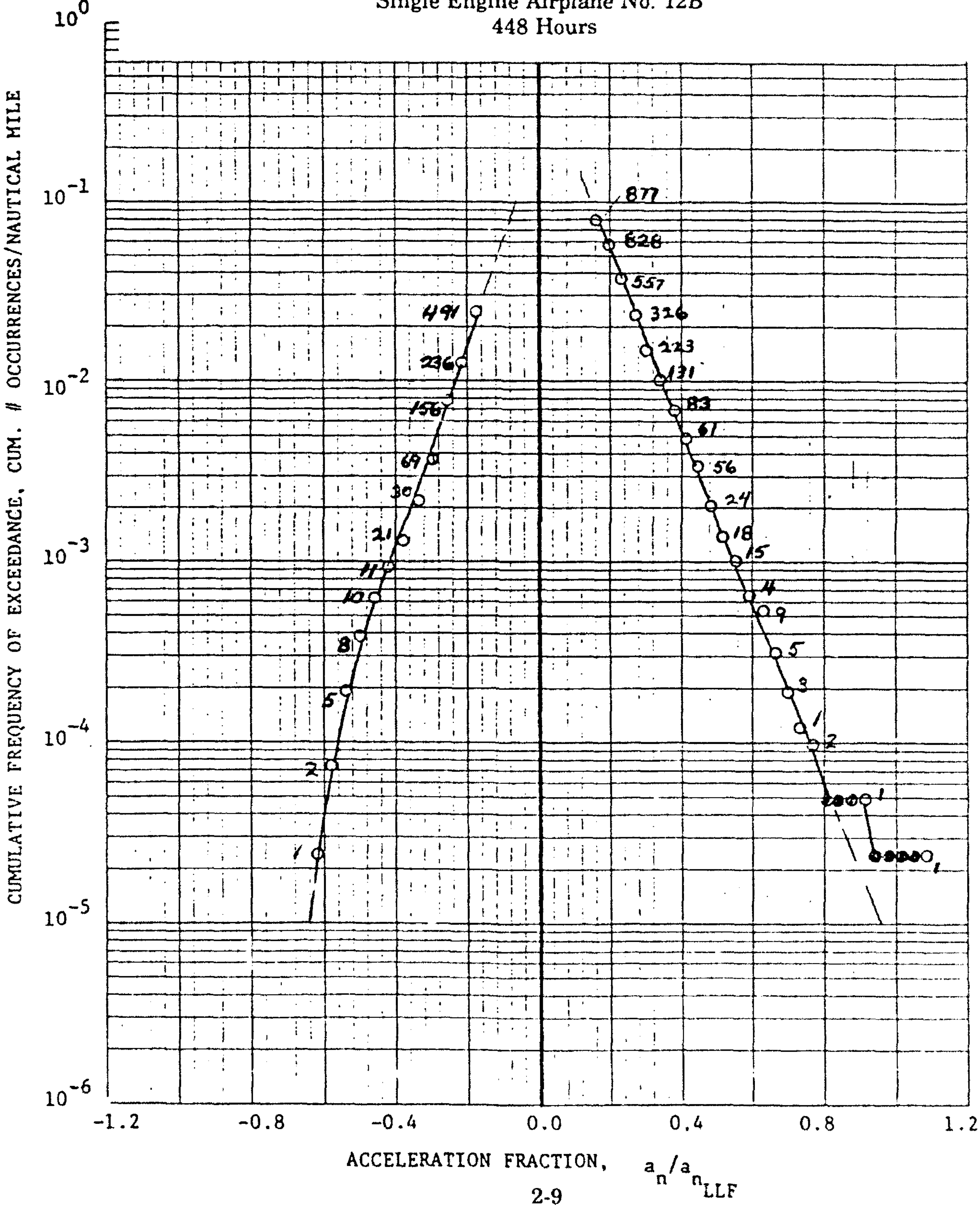
When normal acceleration data is recorded over many flights there will be a large number of occurrences at low acceleration levels and very few occurrences at high acceleration levels. This is illustrated in Figure 2-1. The number of accelerometer counts (not cumulative) is indicated by each data point. It is evident, from the number of counts, that there is great confidence in the upper part of the spectra and the least confidence in the lowest part. Note that the ordinate values are cumulative occurrences per nautical mile. There are no accelerometer counts associated with the shaded data points; these points are the result of cumulative data processing. In this case, the data for the positive maneuver spectrum low frequency end of the curve is as follows:

Incremental accel. range	Number of occurrences	Cumulative number of occurrences	Accel. fraction	Cumulative occurrences per nau.mi.
3.0 to 3.1	1	1	1.089	2.468×10^{-5}
2.9 - 3.0	0	1	1.054	2.468
2.8 - 2.9	0	1	1.018	2.468
2.7 - 2.8	0	1	0.982	2.468
2.6 - 2.7	0	1	0.946	2.468
2.5 - 2.6	1	2	0.911	4.935
2.4 - 2.5	0	2	0.875	4.935

It is seen that when there are no occurrences, cumulative data points are plotted at constant cumulative frequency until there is another occurrence. The next data point when there is a non-zero count is plotted at a higher cumulative frequency. The zero counts result in there being a number of cumulative data points that do not fit the trend line of the majority of the data. Also it is expected that if recording of flight data were continued, these high g data points would be plotted at a lower cumulative frequency (because of the greater total distance flown) and fall closer to the data trend line. In order that these cumulative repeat points with zero counts would not unduly affect extrapolation of the data trend line, the curve fit program was instructed to neglect any repeat points at high acceleration fractions having the same value of cumulative frequency as the previous point. This same problem was discussed in Reference 15 for gust exceedance curves and a similar solution was employed.

Figure 2-1:

Maneuver Spectrum
Basic Flight Instruction
Single Engine Airplane No. 12B[1]
448 Hours



2.5 Statistically Derived Exceedance Curves

The development of acceleration cumulative exceedance curves are the principal goal of this work. For each of the operational usage groups shown in Table 2-1, the following load spectra are presented: the weighted mean (based on flight hours), the weighted mean plus one, two, and three standard deviations, and the 90% probability/95% confidence level. Results are also presented for groups 1a and 1b combined and groups 2 and 5 combined, for a total of nine statistical groups. All results (plotted and tabular) are presented as cumulative number of occurrences (cumulative frequency of exceedance) of normal accelerations per nautical mile versus acceleration fraction. Plotted results are also presented with the original airplane data in Appendix D. The following is an overview of the statistical analysis process (a more detailed explanation is given in Appendices D and E):

1. Curve fit the original data for each of the airplanes identified in Table 2-1. This produces a best fit equation for the cumulative frequency of exceedance as a function of acceleration fraction. Plotted and tabulated results obtained from the curve fit equations are presented with the original airplane data in Appendix C. Results are also presented for airplanes not included in the statistical analysis. These are denoted as non-statistical airplanes.

2. For each operational usage group, compute the weighted mean and weighted standard deviation as a function of acceleration fraction. These statistics are calculated by passing a vertical cut through each of the curve fits at a given acceleration fraction. To improve the estimate for the standard deviation, a pooled standard deviation is used for all spectra except the group 3 (Aerial Application) maneuver spectra.

3. Compute the 90% probability/95% confidence level (referred to as the 90/95% spectra). With the exception of group 3, a pooled standard deviation is also used for this spectra. The use of a pooled standard deviation minimizes potential uncertainties when dealing with small sample sizes (e.g., groups 5 and 6, three airplanes; group 2, four airplanes) and results in more consistent estimates for the 90/95% spectra within each operational usage group.

4. Analyze the distribution of the original data. All of the above-mentioned spectra are based on the assumption that the data is from a normal population. To examine whether this assumption is reasonable, all of the airplanes used for the statistical analysis are included in one group, and histograms for the cumulative frequency of exceedance are generated by passing a vertical cut through all of the airplane curve fits at a given acceleration fraction. The validity of pooling the group variances is also examined (Appendix E) using Bartlett's Test of Variance Homogeneity (Reference 16).

Table 2-2 Gust Load Spectra: Single-Engine General Usage, Basic Flight Instruction

Accel. Fraction	Weighted mean	+1 std. dev.	+2 std. dev.	+3 std. dev.	90/95% spectra	Accel. Fraction	Weighted mean	+1 std. dev.	+2 std. dev.	+3 std. dev.	90/95% spectra
-0.150	0.45548E+00	0.16421E+01	0.28286E+01	0.40152E+01	0.25936E+01	0.150	0.29359E+00	0.55986E+01	0.10904E+02	0.16209E+02	0.98526E+01
-0.200	0.40375E-01	0.19856E+00	0.35675E+00	0.51494E+00	0.32542E+00	0.200	0.38107E-01	0.49965E+00	0.96120E+00	0.14227E+01	0.86976E+00
-0.250	0.70736E-02	0.40576E-01	0.74079E-01	0.10758E+00	0.67441E-01	0.250	0.82916E-02	0.80988E-01	0.15368E+00	0.22638E+00	0.13928E+00
-0.300	0.17177E-02	0.11204E-01	0.20691E-01	0.30177E-01	0.18811E-01	0.300	0.23728E-02	0.19029E-01	0.35686E-01	0.52342E-01	0.32386E-01
-0.350	0.51276E-03	0.37885E-02	0.70643E-02	0.10340E-01	0.64154E-02	0.350	0.79328E-03	0.57336E-02	0.10674E-01	0.15614E-01	0.96952E-02
-0.400	0.18389E-03	0.14896E-02	0.27954E-02	0.41011E-02	0.25367E-02	0.400	0.29218E-03	0.20614E-02	0.38306E-02	0.55998E-02	0.34801E-02
-0.450	0.78659E-04	0.65856E-03	0.12385E-02	0.18184E-02	0.11236E-02	0.450	0.11558E-03	0.84695E-03	0.15783E-02	0.23097E-02	0.14334E-02
-0.500	0.39487E-04	0.31958E-03	0.59967E-03	0.87976E-03	0.54418E-03	0.500	0.48814E-04	0.38728E-03	0.72575E-03	0.10642E-02	0.65870E-03
-0.550	0.22246E-04	0.16686E-03	0.31147E-03	0.45608E-03	0.28282E-03	0.550	0.21785E-04	0.19335E-03	0.36491E-03	0.53647E-03	0.33092E-03
-0.600	0.13340E-04	0.92142E-04	0.17094E-03	0.24975E-03	0.15533E-03	0.600	0.10221E-04	0.10394E-03	0.19766E-03	0.29138E-03	0.17909E-03
-0.650	0.83018E-05	0.53187E-04	0.98071E-04	0.14296E-03	0.89179E-04	0.650	0.50626E-05	0.59563E-04	0.11406E-03	0.16856E-03	0.10327E-03
-0.700	0.52831E-05	0.31806E-04	0.58329E-04	0.84852E-04	0.53075E-04	0.700	0.26307E-05	0.36051E-04	0.69472E-04	0.10289E-03	0.62851E-04
-0.750	0.34176E-05	0.19581E-04	0.35744E-04	0.51907E-04	0.32542E-04	0.750	0.14218E-05	0.22869E-04	0.44316E-04	0.65764E-04	0.40068E-04
-0.800	0.22378E-05	0.12347E-04	0.22456E-04	0.32565E-04	0.20453E-04	0.800	0.79204E-06	0.15109E-04	0.29425E-04	0.43742E-04	0.26589E-04
-0.850	0.14785E-05	0.79422E-05	0.14406E-04	0.20870E-04	0.13125E-04	0.850	0.45107E-06	0.10342E-04	0.20233E-04	0.30124E-04	0.18274E-04
-0.900	0.98337E-06	0.51947E-05	0.94061E-05	0.13617E-04	0.85718E-05	0.900	0.26093E-06	0.73044E-05	0.14348E-04	0.21391E-04	0.12953E-04
-0.950	0.65731E-06	0.34457E-05	0.62340E-05	0.90224E-05	0.56816E-05	0.950	0.15259E-06	0.53047E-05	0.10457E-04	0.15609E-04	0.94361E-05
-1.000	0.44099E-06	0.23128E-05	0.41845E-05	0.60563E-05	0.38137E-05	1.000	0.89899E-07	0.39495E-05	0.78092E-05	0.11669E-04	0.70446E-05
-1.050	0.29668E-06	0.15681E-05	0.28395E-05	0.41109E-05	0.25876E-05	1.050	0.53238E-07	0.30072E-05	0.59611E-05	0.89150E-05	0.53759E-05
-1.100	0.20000E-06	0.10724E-05	0.19448E-05	0.28172E-05	0.17719E-05	1.100	0.31640E-07	0.23363E-05	0.46410E-05	0.69456E-05	0.41844E-05
-1.150	0.13503E-06	0.73882E-06	0.13426E-05	0.19464E-05	0.12230E-05	1.150	0.18851E-07	0.18485E-05	0.36781E-05	0.55077E-05	0.33156E-05
-1.200	0.91271E-07	0.51225E-06	0.93323E-06	0.13542E-05	0.84984E-06	1.200	0.11251E-07	0.14868E-05	0.29624E-05	0.44379E-05	0.26700E-05

Figure 2-2 Gust Load Spectra: Single-Engine General Usage, Basic Flight Instruction

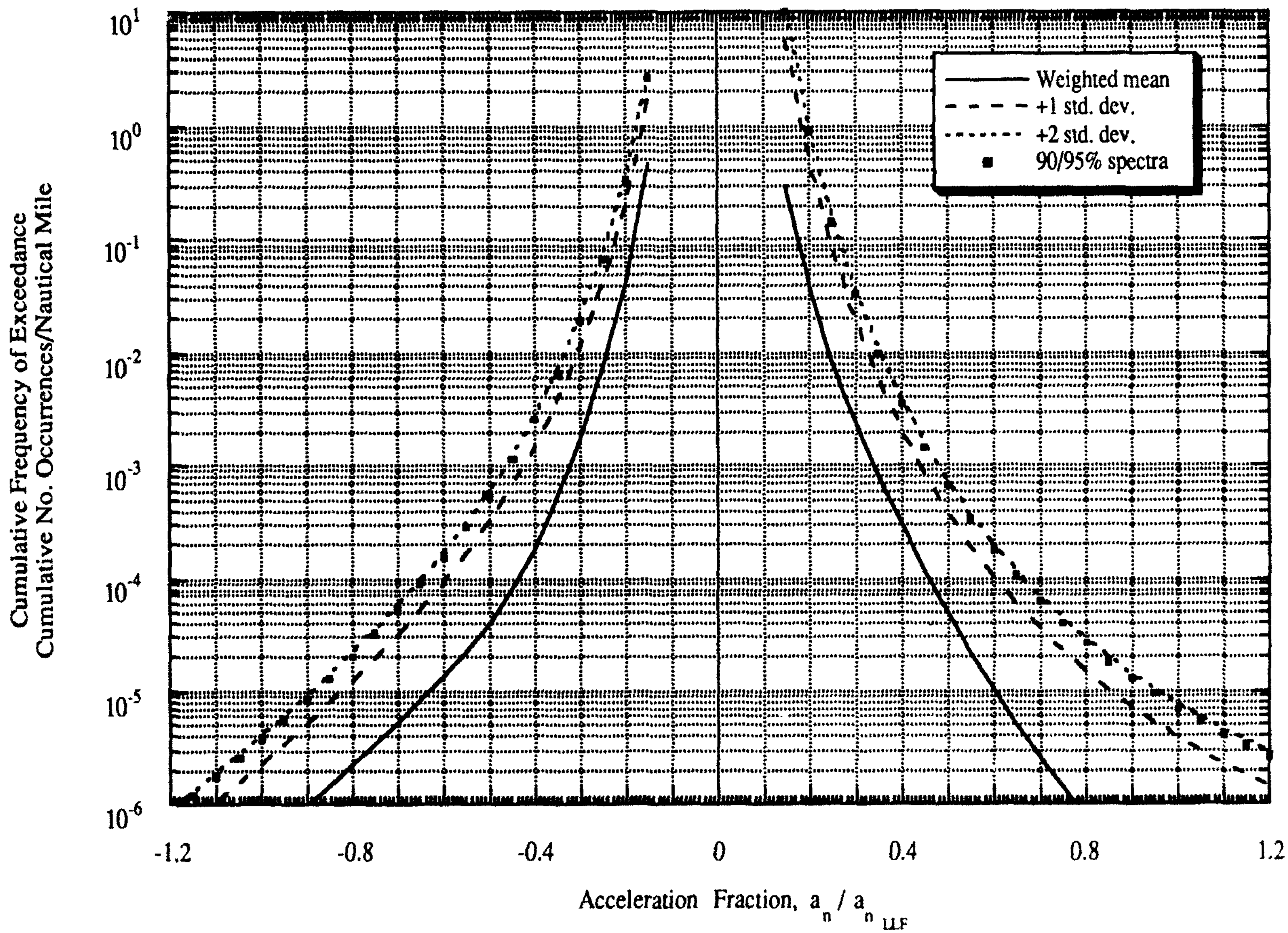


Table 2-3 Maneuver Load Spectra: Single-Engine General Usage, Basic Flight Instruction

Accel. Fraction	Weighted mean	+1 std. dev.	+2 std. dev.	+3 std. dev.	90/95 % spectra
-0.150	0.38504E-01	0.23146E+00	0.42442E+00	0.61738E+00	0.38619E+00
-0.200	0.13204E-01	0.27608E-01	0.42013E-01	0.56417E-01	0.39159E-01
-0.250	0.46596E-02	0.72393E-02	0.98190E-02	0.12399E-01	0.93079E-02
-0.300	0.16172E-02	0.23753E-02	0.31333E-02	0.38914E-02	0.29832E-02
-0.350	0.56524E-03	0.86377E-03	0.11623E-02	0.14608E-02	0.11032E-02
-0.400	0.20944E-03	0.34903E-03	0.48862E-03	0.62821E-03	0.46096E-03
-0.450	0.84493E-04	0.15618E-03	0.22787E-03	0.29955E-03	0.21366E-03
-0.500	0.36545E-04	0.74882E-04	0.11322E-03	0.15156E-03	0.10562E-03
-0.550	0.16289E-04	0.36843E-04	0.57397E-04	0.77951E-04	0.53325E-04
-0.600	0.72878E-05	0.18030E-04	0.28772E-04	0.39514E-04	0.26644E-04
-0.650	0.32933E-05	0.86505E-05	0.14008E-04	0.19365E-04	0.12946E-04
-0.700	0.15208E-05	0.40285E-05	0.65362E-05	0.90439E-05	0.60394E-05
-0.750	0.71634E-06	0.18037E-05	0.28911E-05	0.39785E-05	0.26757E-05
-0.800	0.34366E-06	0.77584E-06	0.12080E-05	0.16402E-05	0.11224E-05

Accel. Fraction	Weighted mean	+1 std. dev.	+2 std. dev.	+3 std. dev.	90/95 % spectra
0.150	0.62051E-01	0.18204E+00	0.30203E+00	0.42203E+00	0.27826E+00
0.200	0.26695E-01	0.52769E-01	0.78843E-01	0.10492E+00	0.73677E-01
0.250	0.13235E-01	0.21826E-01	0.30417E-01	0.39008E-01	0.28715E-01
0.300	0.70607E-02	0.10708E-01	0.14355E-01	0.18003E-01	0.13633E-01
0.350	0.39328E-02	0.57621E-02	0.75913E-02	0.94206E-02	0.72289E-02
0.400	0.22582E-02	0.32873E-02	0.43163E-02	0.53453E-02	0.41124E-02
0.450	0.13310E-02	0.19589E-02	0.25869E-02	0.32148E-02	0.24625E-02
0.500	0.80485E-03	0.12111E-02	0.16174E-02	0.20237E-02	0.15369E-02
0.550	0.49884E-03	0.77305E-03	0.10473E-02	0.13215E-02	0.99295E-03
0.600	0.31638E-03	0.50713E-03	0.69789E-03	0.88865E-03	0.66010E-03
0.650	0.20513E-03	0.34065E-03	0.47618E-03	0.61171E-03	0.44933E-03
0.700	0.13565E-03	0.23329E-03	0.33094E-03	0.42858E-03	0.31159E-03
0.750	0.91263E-04	0.16221E-03	0.23315E-03	0.30409E-03	0.21909E-03
0.800	0.62356E-04	0.11410E-03	0.16584E-03	0.21758E-03	0.15559E-03
0.850	0.43203E-04	0.80944E-04	0.11868E-03	0.15642E-03	0.11121E-03
0.900	0.30291E-04	0.57739E-04	0.85186E-04	0.11263E-03	0.79748E-04
0.950	0.21457E-04	0.41309E-04	0.61160E-04	0.81012E-04	0.57227E-04
1.000	0.15335E-04	0.29583E-04	0.43830E-04	0.58078E-04	0.41008E-04
1.050	0.11040E-04	0.21168E-04	0.31297E-04	0.41425E-04	0.29290E-04
1.100	0.79954E-05	0.15116E-04	0.22236E-04	0.29356E-04	0.20825E-04
1.150	0.58187E-05	0.10762E-04	0.15705E-04	0.20648E-04	0.14726E-04
1.200	0.42515E-05	0.76362E-05	0.11021E-04	0.14406E-04	0.10350E-04

Figure 2-3 Maneuver Load Spectra: Single-Engine General Usage, Basic Flight Instruction

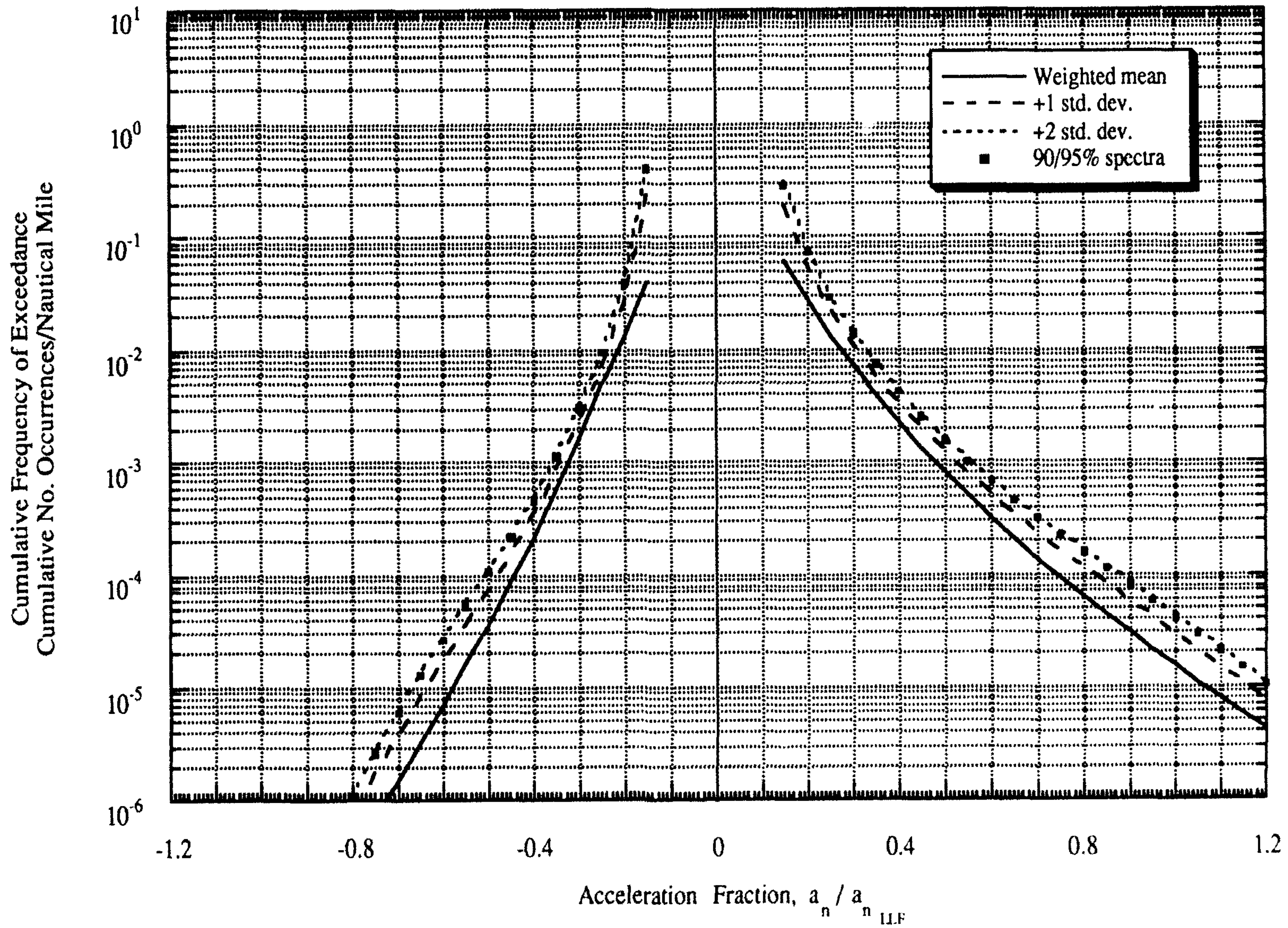


Table 2-4 Gust Load Spectra: Single-Engine General Usage, Business/Personal

Accel. Fraction	Weighted mean	+1 std. dev.	+2 std. dev.	+3 std. dev.	90/95% spectra	Accel. Fraction	Weighted mean	+1 std. dev.	+2 std. dev.	+3 std. dev.	90/95% spectra
-0.100	0.15587E+01	0.22383E+02	0.43208E+02	0.64032E+02	0.35242E+02	0.100	0.12287E+02	0.19267E+03	0.37305E+03	0.55343E+03	0.30405E+03
-0.150	0.16670E+00	0.13533E+01	0.25399E+01	0.37265E+01	0.20860E+01	0.150	0.24866E+00	0.55536E+01	0.10859E+02	0.16164E+02	0.88294E+01
-0.200	0.36992E-01	0.19518E+00	0.35337E+00	0.51156E+00	0.29286E+00	0.200	0.45809E-01	0.50735E+00	0.96890E+00	0.14304E+01	0.79235E+00
-0.250	0.11112E-01	0.44614E-01	0.78117E-01	0.11162E+00	0.65301E-01	0.250	0.12966E-01	0.85663E-01	0.15836E+00	0.23106E+00	0.13055E+00
-0.300	0.37851E-02	0.13272E-01	0.22758E-01	0.32245E-01	0.19129E-01	0.300	0.44038E-02	0.21060E-01	0.37717E-01	0.54373E-01	0.31345E-01
-0.350	0.13487E-02	0.46244E-02	0.79002E-02	0.11176E-01	0.66472E-02	0.350	0.16529E-02	0.65932E-02	0.11533E-01	0.16474E-01	0.96437E-02
-0.400	0.48441E-03	0.17902E-02	0.30959E-02	0.44016E-02	0.25964E-02	0.400	0.66228E-03	0.24315E-02	0.42007E-02	0.59699E-02	0.35239E-02
-0.450	0.17298E-03	0.75288E-03	0.13328E-02	0.19127E-02	0.11110E-02	0.450	0.27833E-03	0.10097E-02	0.17411E-02	0.24724E-02	0.14613E-02
-0.500	0.61618E-04	0.34171E-03	0.62180E-03	0.90189E-03	0.51466E-03	0.500	0.12153E-03	0.46000E-03	0.79848E-03	0.11369E-02	0.66900E-03
-0.550	0.22291E-04	0.16690E-03	0.31151E-03	0.45613E-03	0.25620E-03	0.550	0.54934E-04	0.22650E-03	0.39806E-03	0.56962E-03	0.33243E-03
-0.600	0.84159E-05	0.87218E-04	0.16602E-03	0.24482E-03	0.13588E-03	0.600	0.25751E-04	0.11947E-03	0.21319E-03	0.30691E-03	0.17734E-03
-0.650	0.34065E-05	0.48291E-04	0.93176E-04	0.13806E-03	0.76007E-04	0.650	0.12611E-04	0.67112E-04	0.12161E-03	0.17611E-03	0.10077E-03
-0.700	0.14771E-05	0.28000E-04	0.54523E-04	0.81046E-04	0.44378E-04	0.700	0.65081E-05	0.39929E-04	0.73349E-04	0.10677E-03	0.60565E-04
-0.750	0.67559E-06	0.16839E-04	0.33002E-04	0.49165E-04	0.26819E-04	0.750	0.35311E-05	0.24978E-04	0.46426E-04	0.67873E-04	0.38222E-04
-0.800	0.32129E-06	0.10430E-04	0.20540E-04	0.30649E-04	0.16673E-04	0.800	0.19987E-05	0.16315E-04	0.30632E-04	0.44948E-04	0.25155E-04
-0.850	0.15709E-06	0.66208E-05	0.13085E-04	0.19548E-04	0.10612E-04	0.850	0.11700E-05	0.11061E-04	0.20952E-04	0.30843E-04	0.17169E-04
-0.900	0.78327E-07	0.42897E-05	0.85011E-05	0.12712E-04	0.68902E-05	0.900	0.70272E-06	0.77462E-05	0.14790E-04	0.21833E-04	0.12095E-04
-0.950	0.39606E-07	0.28280E-05	0.56163E-05	0.84046E-05	0.45497E-05	0.950	0.43023E-06	0.55823E-05	0.10734E-04	0.15886E-04	0.87636E-05
-1.000	0.20233E-07	0.18920E-05	0.37638E-05	0.56355E-05	0.30478E-05	1.000	0.26718E-06	0.41268E-05	0.79864E-05	0.11846E-04	0.65101E-05
-1.050	0.10417E-07	0.12818E-05	0.25532E-05	0.38246E-05	0.20669E-05	1.050	0.16768E-06	0.31216E-05	0.60755E-05	0.90294E-05	0.49456E-05
-1.100	0.53955E-08	0.87778E-06	0.17502E-05	0.26226E-05	0.14165E-05	1.100	0.10608E-06	0.24107E-05	0.47154E-05	0.70201E-05	0.38338E-05
-1.150	0.28083E-08	0.60660E-06	0.12104E-05	0.18142E-05	0.97943E-06	1.150	0.67530E-07	0.18971E-05	0.37268E-05	0.55564E-05	0.30269E-05
-1.200	0.14676E-08	0.42245E-06	0.84343E-06	0.12644E-05	0.68240E-06	1.200	0.43198E-07	0.15188E-05	0.29943E-05	0.44699E-05	0.24299E-05

Figure 2-4 Gust Load Spectra: Single-Engine General Usage, Business/Personal

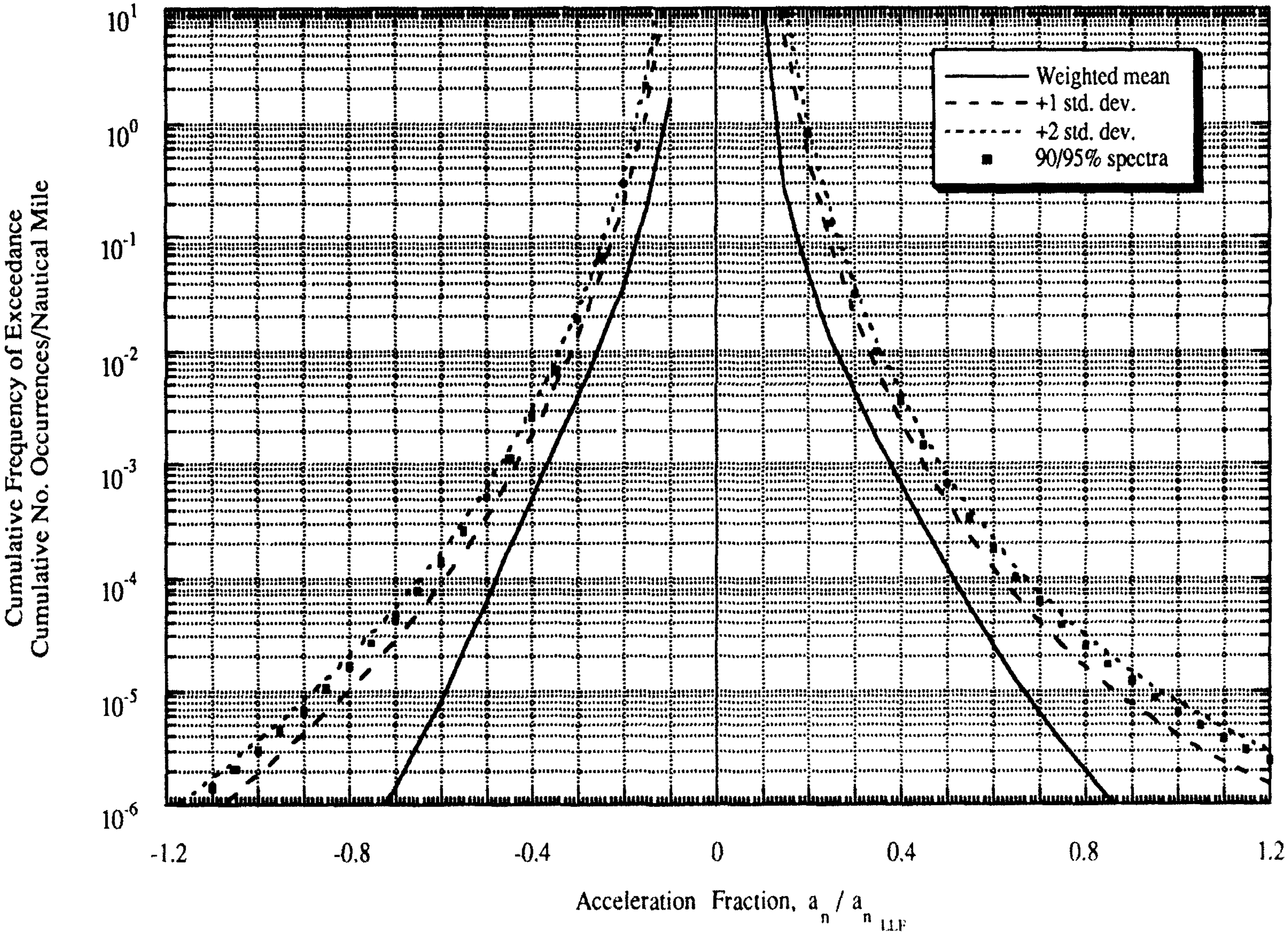


Table 2-5 Maneuver Load Spectra: Single-Engine General Usage, Business/Personal

Accel. Fraction	Weighted mean	+1 std. dev.	+2 std. dev.	+3 std. dev.	90/95% spectra
-0.100	0.73855E+00	0.15284E+02	0.29830E+02	0.44375E+02	0.24483E+02
-0.150	0.39882E-01	0.23284E+00	0.42580E+00	0.61876E+00	0.35487E+00
-0.200	0.58382E-02	0.20243E-01	0.34647E-01	0.49052E-01	0.29352E-01
-0.250	0.14811E-02	0.40607E-02	0.66404E-02	0.92201E-02	0.56922E-02
-0.300	0.49924E-03	0.12573E-02	0.20154E-02	0.27735E-02	0.17368E-02
-0.350	0.19225E-03	0.49078E-03	0.78931E-03	0.10878E-02	0.67958E-03
-0.400	0.79440E-04	0.21903E-03	0.35862E-03	0.49821E-03	0.30731E-03
-0.450	0.35032E-04	0.10672E-03	0.17840E-03	0.25009E-03	0.15205E-03
-0.500	0.16566E-04	0.54903E-04	0.93240E-04	0.13158E-03	0.79148E-04
-0.550	0.83974E-05	0.28951E-04	0.49505E-04	0.70059E-04	0.41950E-04
-0.600	0.44654E-05	0.15207E-04	0.25949E-04	0.36692E-04	0.22001E-04
-0.650	0.24260E-05	0.77832E-05	0.13141E-04	0.18498E-04	0.11171E-04
-0.700	0.13397E-05	0.38474E-05	0.63551E-05	0.88628E-05	0.54333E-05
-0.750	0.74910E-06	0.18365E-05	0.29239E-05	0.40113E-05	0.25242E-05
-0.800	0.42290E-06	0.85508E-06	0.12873E-05	0.17195E-05	0.11284E-05

Accel. Fraction	Weighted mean	+1 std. dev.	+2 std. dev.	+3 std. dev.	90/95% spectra
0.050	0.61587E+02	0.14673E+03	0.23188E+03	0.31702E+03	0.19931E+03
0.100	0.23157E+00	0.14384E+01	0.26451E+01	0.38519E+01	0.21835E+01
0.150	0.23088E-01	0.14308E+00	0.26307E+00	0.38306E+00	0.21717E+00
0.200	0.57869E-02	0.31861E-01	0.57934E-01	0.84008E-01	0.47961E-01
0.250	0.21233E-02	0.10714E-01	0.19305E-01	0.27896E-01	0.16019E-01
0.300	0.88929E-03	0.45366E-02	0.81839E-02	0.11831E-01	0.67888E-02
0.350	0.38942E-03	0.22187E-02	0.40479E-02	0.58772E-02	0.33482E-02
0.400	0.17507E-03	0.12041E-02	0.22331E-02	0.32622E-02	0.18395E-02
0.450	0.82119E-04	0.71006E-03	0.13380E-02	0.19660E-02	0.10978E-02
0.500	0.40505E-04	0.44679E-03	0.85308E-03	0.12594E-02	0.69767E-03
0.550	0.21143E-04	0.29536E-03	0.56958E-03	0.84379E-03	0.46468E-03
0.600	0.11830E-04	0.20259E-03	0.39334E-03	0.58410E-03	0.32038E-03
0.650	0.71354E-05	0.14266E-03	0.27819E-03	0.41372E-03	0.22635E-03
0.700	0.46319E-05	0.10228E-03	0.19992E-03	0.29757E-03	0.16257E-03
0.750	0.32163E-05	0.74159E-04	0.14510E-03	0.21604E-03	0.11796E-03
0.800	0.23658E-05	0.54106E-04	0.10585E-03	0.15759E-03	0.86055E-04
0.850	0.18227E-05	0.39563E-04	0.77303E-04	0.11504E-03	0.62867E-04
0.900	0.14549E-05	0.28902E-04	0.56350E-04	0.83797E-04	0.45851E-04
0.950	0.11921E-05	0.21044E-04	0.40895E-04	0.60747E-04	0.33302E-04
1.000	0.99562E-06	0.15243E-04	0.29491E-04	0.43739E-04	0.24041E-04
1.050	0.84302E-06	0.10971E-04	0.21100E-04	0.31228E-04	0.17226E-04
1.100	0.72099E-06	0.78412E-05	0.14961E-04	0.22082E-04	0.12238E-04
1.150	0.62116E-06	0.55642E-05	0.10507E-04	0.15450E-04	0.86164E-05
1.200	0.53809E-06	0.39228E-05	0.73075E-05	0.10692E-04	0.60128E-05

Figure 2-5 Maneuver Load Spectra: Single-Engine General Usage, Business/Personal

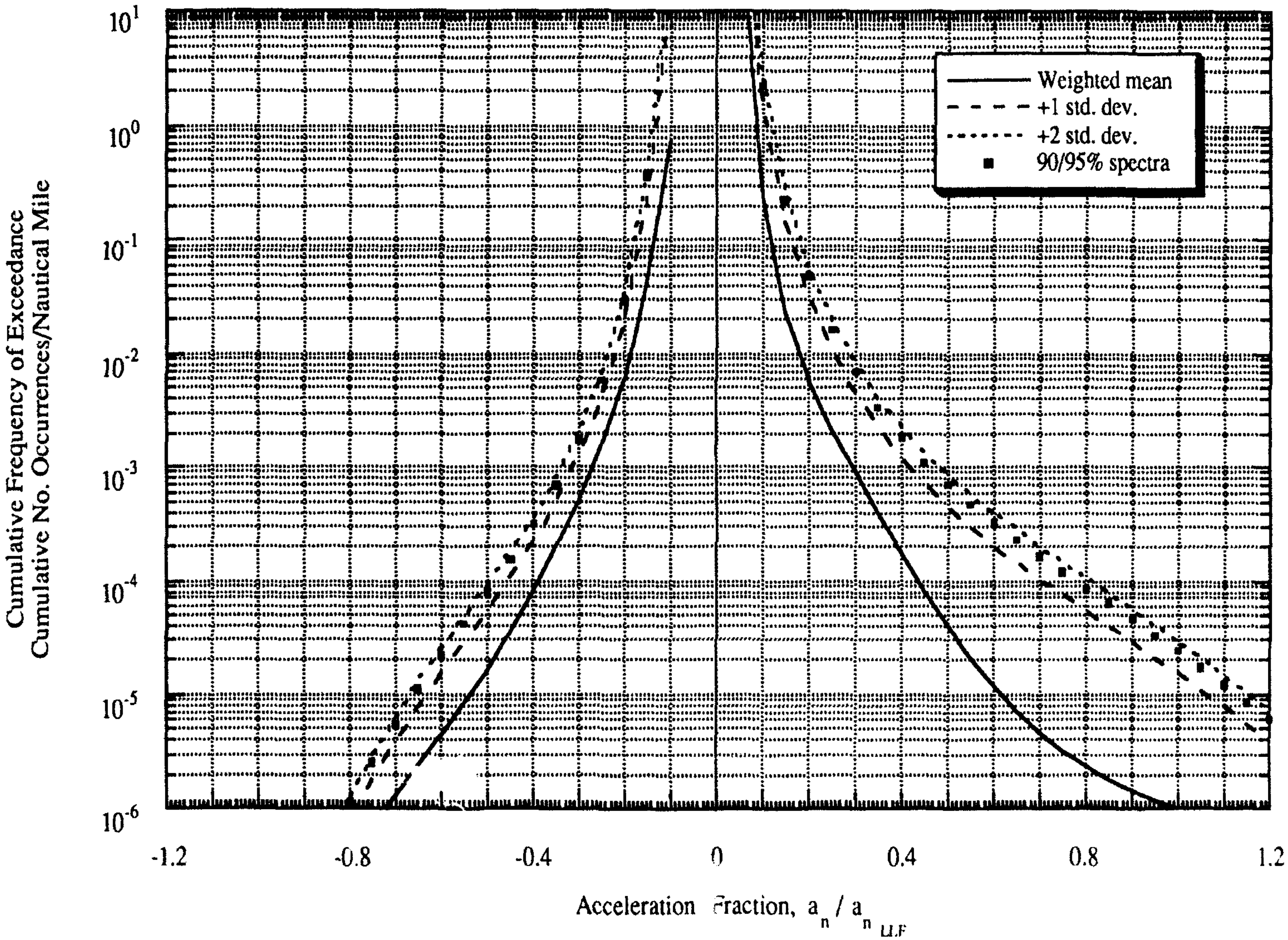


Table 2-6 Gust Load Spectra: Single-Engine General Usage (Basic Flight Instruction and Business/Personal Combined)

Accel. Fraction	Weighted mean	+1 std.dev.	+2 std.dev.	+3 std.dev.	90/95 % spectra	Accel. Fraction	Weighted mean	+1 std.dev.	+2 std.dev.	+3 std.dev.	90/95 % spectra
-0.100	0.10326E+02	0.31151E+02	0.51975E+02	0.72800E+02	0.42892E+02	0.100	0.97302E+01	0.19011E+03	0.37049E+03	0.55088E+03	0.29181E+03
-0.150	0.29097E+00	0.14776E+01	0.26641E+01	0.38507E+01	0.21466E+01	0.150	0.26799E+00	0.55730E+01	0.10878E+02	0.16183E+02	0.85640E+01
-0.200	0.38448E-01	0.19664E+00	0.35483E+00	0.51302E+00	0.28583E+00	0.200	0.42495E-01	0.50404E+00	0.96558E+00	0.14271E+01	0.76427E+00
-0.250	0.93739E-02	0.42876E-01	0.76379E-01	0.10988E+00	0.61766E-01	0.250	0.10955E-01	0.83651E-01	0.15635E+00	0.22904E+00	0.12464E+00
-0.300	0.28954E-02	0.12382E-01	0.21868E-01	0.31355E-01	0.17731E-01	0.300	0.35298E-02	0.20186E-01	0.36843E-01	0.53499E-01	0.29577E-01
-0.350	0.98894E-03	0.42647E-02	0.75405E-02	0.10816E-01	0.61117E-02	0.350	0.12830E-02	0.62233E-02	0.11164E-01	0.16104E-01	0.90087E-02
-0.400	0.35509E-03	0.16608E-02	0.29666E-02	0.42723E-02	0.23970E-02	0.400	0.50302E-03	0.22722E-02	0.40414E-02	0.58106E-02	0.32697E-02
-0.450	0.13239E-03	0.71229E-03	0.12922E-02	0.18721E-02	0.10392E-02	0.450	0.20830E-03	0.93967E-03	0.16710E-02	0.24024E-02	0.13520E-02
-0.500	0.52094E-04	0.33218E-03	0.61228E-03	0.89237E-03	0.49010E-03	0.500	0.90242E-04	0.42871E-03	0.76718E-03	0.11057E-02	0.61955E-03
-0.550	0.22272E-04	0.16688E-03	0.31149E-03	0.45611E-03	0.24842E-03	0.550	0.40669E-04	0.21223E-03	0.38379E-03	0.55535E-03	0.30896E-03
-0.600	0.10535E-04	0.89337E-04	0.16814E-03	0.24694E-03	0.13377E-03	0.600	0.19068E-04	0.11279E-03	0.20650E-03	0.30022E-03	0.16563E-03
-0.650	0.55131E-05	0.50398E-04	0.95283E-04	0.14017E-03	0.75704E-04	0.650	0.93629E-05	0.63864E-04	0.11836E-03	0.17286E-03	0.94592E-04
-0.700	0.31149E-05	0.29638E-04	0.56161E-04	0.82684E-04	0.44592E-04	0.700	0.48396E-05	0.38260E-04	0.71680E-04	0.10510E-03	0.57103E-04
-0.750	0.18556E-05	0.18019E-04	0.34182E-04	0.50345E-04	0.27132E-04	0.750	0.26235E-05	0.24071E-04	0.45518E-04	0.66965E-04	0.36163E-04
-0.800	0.11460E-05	0.11255E-04	0.21364E-04	0.31473E-04	0.16955E-04	0.800	0.14794E-05	0.15796E-04	0.30112E-04	0.44429E-04	0.23868E-04
0.850	0.72573E-06	0.71895E-05	0.13653E-04	0.20117E-04	0.10834E-04	0.850	0.86063E-06	0.10752E-04	0.20643E-04	0.30534E-04	0.16328E-04
-0.900	0.46779E-06	0.46792E-05	0.88905E-05	0.13102E-04	0.70536E-05	0.900	0.51261E-06	0.75561E-05	0.14600E-04	0.21643E-04	0.11527E-04
-0.950	0.30542E-06	0.30938E-05	0.58821E-05	0.86705E-05	0.46659E-05	0.950	0.31076E-06	0.54628E-05	0.10615E-04	0.15767E-04	0.83676E-05
-1.000	0.20130E-06	0.20731E-05	0.39448E-05	0.58166E-05	0.31284E-05	1.000	0.19089E-06	0.40505E-05	0.79102E-05	0.11770E-04	0.62266E-05
-1.050	0.13360E-06	0.14050E-05	0.26764E-05	0.39478E-05	0.21218E-05	1.050	0.11843E-06	0.30724E-05	0.60263E-05	0.89802E-05	0.47378E-05
-1.100	0.89139E-07	0.96153E-06	0.18339E-05	0.27063E-05	0.14534E-05	1.100	0.74050E-07	0.23787E-05	0.46834E-05	0.69880E-05	0.36781E-05
-1.150	0.59708E-07	0.66350E-06	0.12673E-05	0.18711E-05	0.10039E-05	1.150	0.46583E-07	0.18762E-05	0.37058E-05	0.55354E-05	0.29078E-05
-1.200	0.40113E-07	0.46109E-06	0.88208E-06	0.13031E-05	0.69845E-06	1.200	0.29450E-07	0.15050E-05	0.29806E-05	0.44561E-05	0.23369E-05

Figure 2-6 Gust Load Spectra: Single Engine General Usage
(Basic Flight Instruction and Business/Personal Combined)

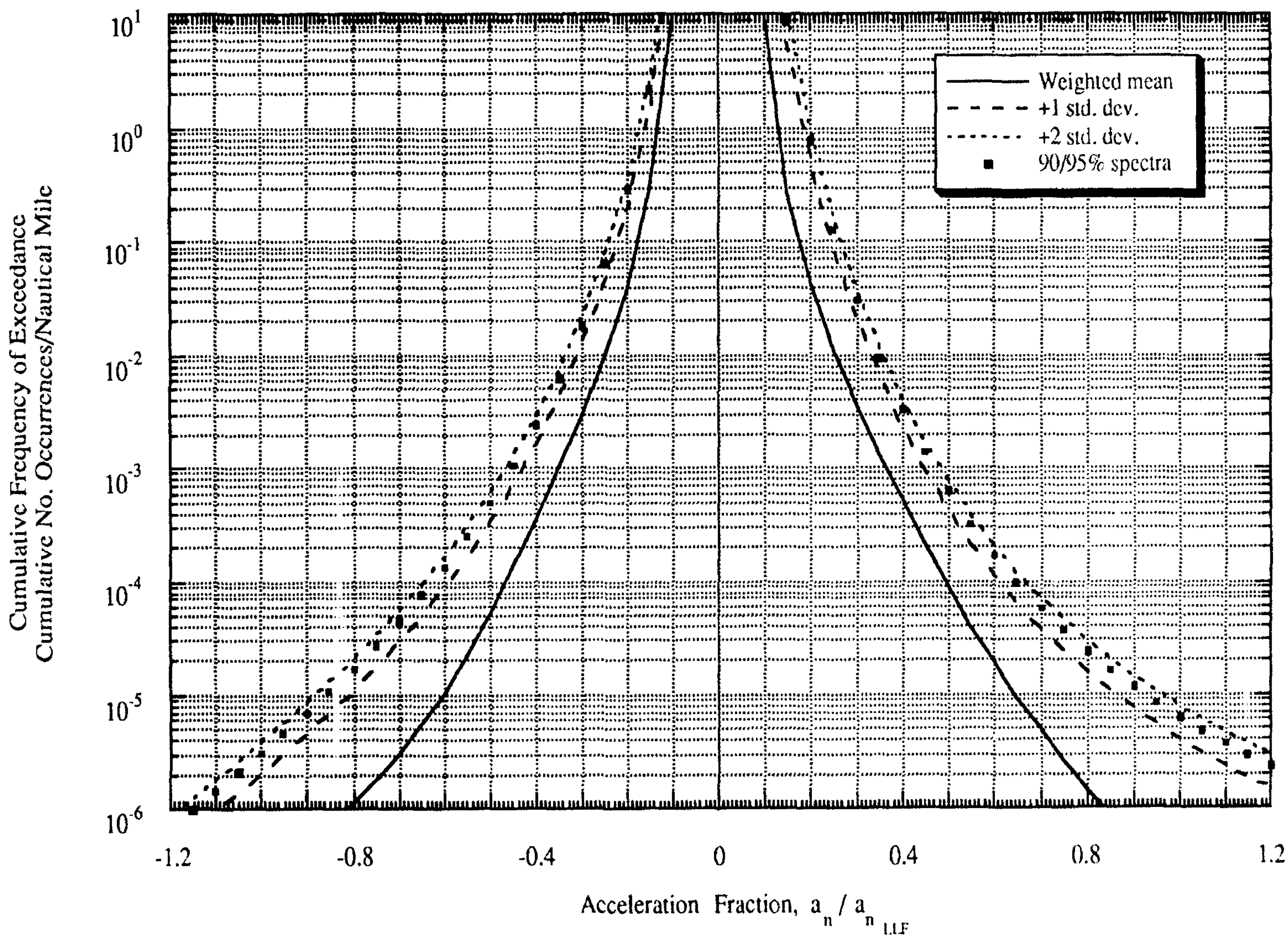


Table 2-7 Maneuver Load Spectra: Single-Engine General Usage (Basic Flight Instruction and Business/Personal Combined)

Accel. Fraction	Weighted mean	+1 std. dev.	+2 std. dev.	+3 std. dev.	90/95 % spectra
-0.100	0.47752E+00	0.15023E+02	0.29568E+02	0.44114E+02	0.23350E+02
-0.150	0.39274E-01	0.23223E+00	0.42519E+00	0.6181[illegible]E+00	0.34270E+00
-0.200	0.90866E-02	0.23491E-01	0.37896E-01	0.52300E-01	0.31738E-01
-0.250	0.28830E-02	0.54627E-02	0.80423E-02	0.10622E-01	0.69395E-02
-0.300	0.99230E-03	0.17504E-02	0.25085E-02	0.32666E-02	0.21844E-02
-0.350	0.35676E-03	0.65529E-03	0.95382E-03	0.12524E-02	0.82620E-03
-0.400	0.13678E-03	0.27636E-03	0.41595E-03	0.55554E-03	0.35628E-03
-0.450	0.56847E-04	0.12853E-03	0.20022E-03	0.27191E-03	0.16957E-03
-0.500	0.25378E-04	0.63715E-04	0.10205E-03	0.14039E-03	0.85662E-04
-0.550	0.11878E-04	0.32432E-04	0.52986E-04	0.73540E-04	0.44199E-04
-0.600	0.57102E-05	0.16452E-04	0.27194E-04	0.37936E-04	0.22602E-04
-0.650	0.28085E-05	0.81658E-05	0.13523E-04	0.18880E-04	0.11233E-04
-0.700	0.14196E-05	0.39273E-05	0.64350E-05	0.89427E-05	0.53629E-05
-0.750	0.73465E-06	0.18220E-05	0.29094E-05	0.39968E-05	0.24446E-05
-0.800	0.38795E-06	0.82013E-06	0.12523E-05	0.16845E-05	0.10676E-05

Accel. Fraction	Weighted mean	+1 std. dev.	+2 std. dev.	+3 std. dev.	90/95 % spectra
0.050	0.35729E+02	0.12087E+03	0.20602E+03	0.29117E+03	0.16888E+03
0.100	0.21663E+00	0.14234E+01	0.26302E+01	0.38370E+01	0.21038E+01
0.150	0.39855E-01	0.15985E+00	0.27984E+00	0.39963E+00	0.22750E+00
0.200	0.14784E-01	0.40858E-01	0.66932E-01	0.93005E-01	0.55559E-01
0.250	0.69049E-02	0.15496E-01	0.24087E-01	0.32678E-01	0.20340E-01
0.300	0.35450E-02	0.71923E-02	0.10840E-01	0.14487E-01	0.92488E-02
0.350	0.19143E-02	0.37435E-02	0.55728E-02	0.74020E-02	0.47749E-02
0.400	0.10715E-02	0.21006E-02	0.31296E-02	0.41586E-02	0.26807E-02
0.450	0.61954E-03	0.12475E-02	0.18754E-02	0.25034E-02	0.16015E-02
0.500	0.36943E-03	0.77571E-03	0.11820E-02	0.15883E-02	0.10048E-02
0.550	0.22671E-03	0.50092E-03	0.77514E-03	0.10494E-02	0.65553E-03
0.600	0.14288E-03	0.33364E-03	0.52440E-03	0.71515E-03	0.44119E-03
0.650	0.92337E-04	0.22786E-03	0.36339E-03	0.49892E-03	0.30428E-03
0.700	0.61012E-04	0.15866E-03	0.25630E-03	0.35395E-03	0.21371E-03
0.750	0.41105E-04	0.11205E-03	0.18299E-03	0.25393E-03	0.15205E-03
0.800	0.28181E-04	0.79922E-04	0.13166E-03	0.18340E-03	0.10909E-03
0.850	0.19630E-04	0.57370E-04	0.95111E-04	0.13285E-03	0.78649E-04
0.900	0.13864E-04	0.41311E-04	0.68759E-04	0.96206E-04	0.56787E-04
0.950	0.99127E-05	0.29764E-04	0.49616E-04	0.69468E-04	0.40957E-04
1.000	0.71663E-05	0.21414E-04	0.35662E-04	0.49909E-04	0.29447E-04
1.050	0.52310E-05	0.15359E-04	0.25488E-04	0.35616E-04	0.21070E-04
1.100	0.38514E-05	0.10972E-04	0.18092E-04	0.25212E-04	0.14986E-04
1.150	0.28578E-05	0.78009E-05	0.12744E-04	0.17687E-04	0.10588E-04
1.200	0.21361E-05	0.55208E-05	0.89055E-05	0.12290E-04	0.74291E-05

Figure 2-7 Maneuver Load Spectra: Single-Engine General Usage
(Basic Flight Instruction and Business/Personal Combined)

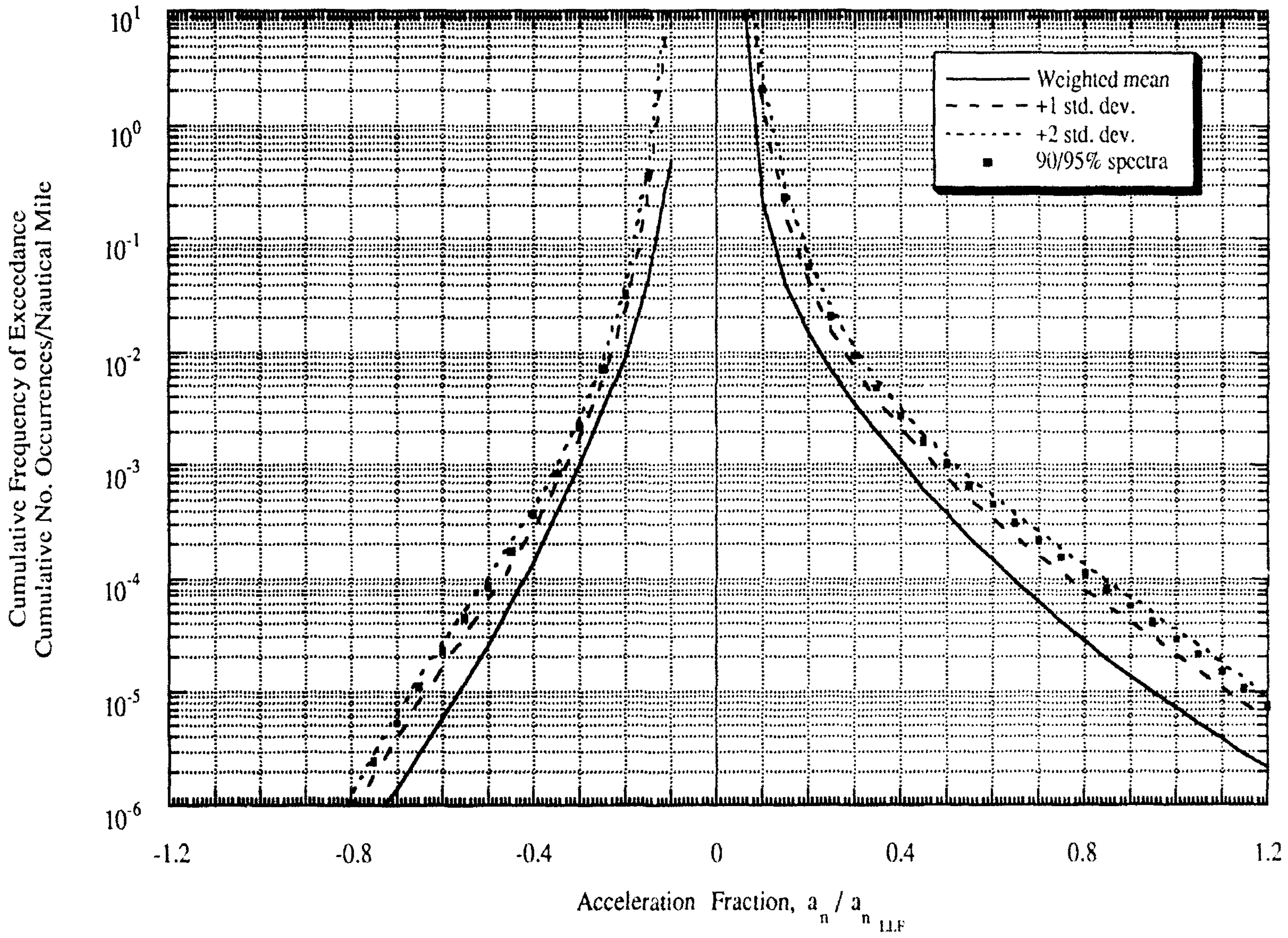


Table 2-8 Gust Load Spectra: Single-Engine Special Usage

Accel. Fraction	Weighted mean	+1 std. dev.	+2 std. dev.	+3 std. dev.	90/95 % spectra	Accel. Fraction	Weighted mean	+1 std. dev.	+2 std. dev.	+3 std. dev.	90/95 % spectra
-0.200	0.56946E+00	0.72765E+00	0.88584E+00	0.10440E+01	0.90232E+00	0.200	0.55419E+00	0.10157E+01	0.14773E+01	0.19388E+01	0.15254E+01
-0.250	0.14888E+00	0.18238E+00	0.21589E+00	0.24939E+00	0.21938E+00	0.250	0.12164E+00	0.19434E+00	0.26704E+00	0.33973E+00	0.27461E+00
-0.300	0.46989E-01	0.56475E-01	0.65962E-01	0.75448E-01	0.66950E-01	0.300	0.34892E-01	0.51548E-01	0.68205E-01	0.84861E-01	0.69940E-01
-0.350	0.16715E-01	0.19991E-01	0.23267E-01	0.26542E-01	0.23608E-01	0.350	0.12158E-01	0.17098E-01	0.22038E-01	0.26979E-01	0.22553E-01
-0.400	0.64446E-02	0.77504E-02	0.90561E-02	0.10362E-01	0.91922E-02	0.400	0.49118E-02	0.66810E-02	0.84502E-02	0.10219E-01	0.86346E-02
-0.450	0.26313E-02	0.32112E-02	0.37911E-02	0.43710E-02	0.38515E-02	0.450	0.22207E-02	0.29520E-02	0.36834E-02	0.44148E-02	0.37596E-02
-0.500	0.11217E-02	0.14018E-02	0.16819E-02	0.19620E-02	0.17111E-02	0.500	0.10913E-02	0.14298E-02	0.17683E-02	0.21068E-02	0.18035E-02
-0.550	0.49486E-03	0.63947E-03	0.78408E-03	0.92869E-03	0.79915E-03	0.550	0.56961E-03	0.74118E-03	0.91274E-03	0.10843E-02	0.93061E-03
-0.600	0.22465E-03	0.30345E-03	0.38225E-03	0.46105E-03	0.39046E-03	0.600	0.31022E-03	0.40394E-03	0.49766E-03	0.59137E-03	0.50742E-03
-0.650	0.10455E-03	0.14943E-03	0.19432E-03	0.23920E-03	0.19900E-03	0.650	0.17407E-03	0.22857E-03	0.28307E-03	0.33757E-03	0.28875E-03
-0.700	0.49717E-04	0.76240E-04	0.10276E-03	0.12929E-03	0.10553E-03	0.700	0.99591E-04	0.13301E-03	0.16643E-03	0.19985E-03	0.16991E-03
-0.750	0.24082E-04	0.40246E-04	0.56409E-04	0.72572E-04	0.58093E-04	0.750	0.57641E-04	0.79088E-04	0.10054E-03	0.12198E-03	0.10277E-03
-0.800	0.11871E-04	0.21980E-04	0.32089E-04	0.42198E-04	0.33142E-04	0.800	0.33597E-04	0.47914E-04	0.62230E-04	0.76547E-04	0.63722E-04
-0.850	0.59454E-05	0.12409E-04	0.18873E-04	0.25337E-04	0.19546E-04	0.850	0.19658E-04	0.29549E-04	0.39440E-04	0.49331E-04	0.40471E-04
-0.900	0.30164E-05	0.72278E-05	0.11439E-04	0.15651E-04	0.11878E-04	0.900	0.11520E-04	0.18564E-04	0.25607E-04	0.32651E-04	0.26341E-04
-0.950	0.15466E-05	0.43349E-05	0.71233E-05	0.99116E-05	0.74138E-05	0.950	0.67581E-05	0.11910E-04	0.17062E-04	0.22214E-04	0.17599E-04
-1.000	0.79999E-06	0.26718E-05	0.45435E-05	0.64153E-05	0.47386E-05	1.000	0.39680E-05	0.78277E-05	0.11687E-04	0.15547E-04	0.12089E-04
-1.050	0.41681E-06	0.16882E-05	0.29596E-05	0.42310E-05	0.30921E-05	1.050	0.23320E-05	0.52859E-05	0.82398E-05	0.11194E-04	0.85476E-05
-1.100	0.21845E-06	0.10908E-05	0.19632E-05	0.28356E-05	0.20541E-05	1.100	0.13717E-05	0.36763E-05	0.59810E-05	0.82856E-05	0.62211E-05
-1.150	0.11504E-06	0.71883E-06	0.13226E-05	0.19264E-05	0.13855E-05	1.150	0.80754E-06	0.26372E-05	0.44668E-05	0.62964E-05	0.46574E-05
-1.200	0.60821E-07	0.48180E-06	0.90278E-06	0.13238E-05	0.94665E-06	1.200	0.47584E-06	0.19514E-05	0.34270E-05	0.49025E-05	0.35807E-05

Figure 2-8 Gust Load Spectra: Single-Engine Special Usage

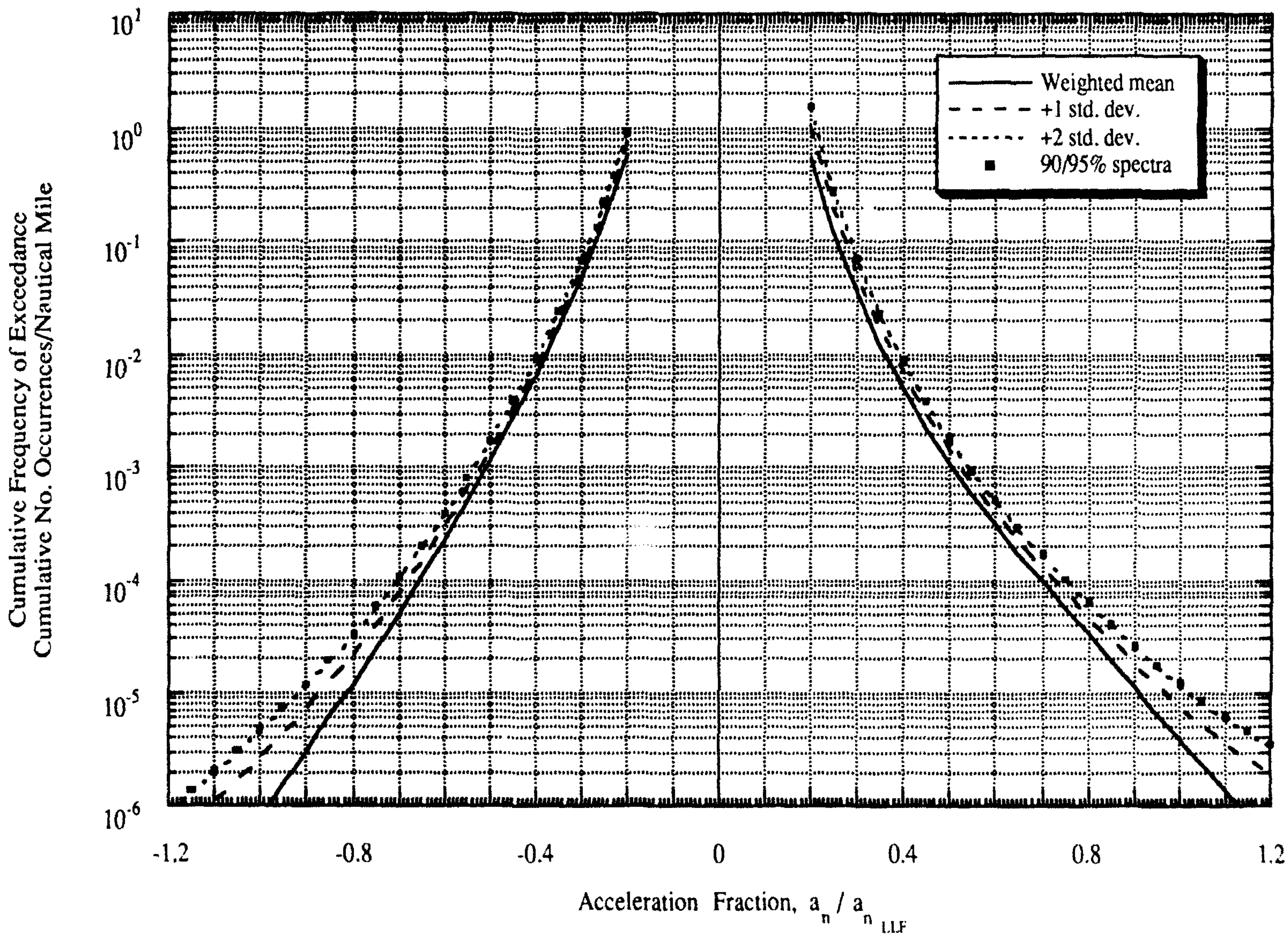


Table 2-9 Maneuver Load Spectra: Single-Engine Special Usage

Accel. Fraction	Weighted mean	+1 std. dev.	+2 std. dev.	+3 std. dev.	90/95 % spectra	Accel. Fraction	Weighted mean	+1 std. dev.	+2 std. dev.	+3 std. dev.	90/95 % spectra
-0.100	0.17799E+01	0.16325E+02	0.30871E+02	0.45416E+02	0.32387E+02	0.100	0.52711E+00	0.17339E+01	0.29407E+01	0.41475E+01	0.30664E+01
-0.150	0.15284E+00	0.34579E+00	0.53875E+00	0.73171E+00	0.55886E+00	0.150	0.21235E+00	0.33235E+00	0.45234E+00	0.57233E+00	0.46484E+00
-0.200	0.25211E-01	0.39616E-01	0.54020E-01	0.68425E-01	0.55521E-01	0.200	0.10205E+00	0.12812E+00	0.15420E+00	0.18027E+00	0.15691E+00
-0.250	0.58126E-02	0.83923E-02	0.10972E-01	0.13552E-01	0.11241E-01	0.250	0.48663E-01	0.57254E-01	0.65845E-01	0.74436E-01	0.66740E-01
-0.300	0.16409E-02	0.23990E-02	0.31571E-02	0.39152E-02	0.32361E-02	0.300	0.21625E-01	0.25272E-01	0.28919E-01	0.32567E-01	0.29300E-01
-0.350	0.53245E-03	0.83098E-03	0.11295E-02	0.14280E-02	0.11606E-02	0.350	0.88699E-02	0.10699E-01	0.12528E-01	0.14358E-01	0.12719E-01
-0.400	0.19276E-03	0.33235E-03	0.47194E-03	0.61153E-03	0.48649E-03	0.400	0.34227E-02	0.44517E-02	0.54808E-02	0.65098E-02	0.55880E-02
-0.450	0.76068E-04	0.14775E-03	0.21944E-03	0.29113E-03	0.22691E-03	0.450	0.12875E-02	0.19154E-02	0.25434E-02	0.31713E-02	0.26088E-02
-0.500	0.31373E-04	0.69710E-04	0.10805E-03	0.14638E-03	0.11204E-03	0.500	0.48947E-03	0.89576E-03	0.13020E-02	0.17083E-02	0.13444E-02
-0.550	0.12690E-04	0.33244E-04	0.53797E-04	0.74351E-04	0.55939E-04	0.550	0.19159E-03	0.46580E-03	0.74002E-03	0.10142E-02	0.76860E-03
-0.600	0.50145E-05	0.15756E-04	0.26499E-04	0.37241E-04	0.27618E-04	0.600	0.76989E-04	0.26775E-03	0.45850E-03	0.64926E-03	0.47838E-03
-0.650	0.20063E-05	0.73636E-05	0.12721E-04	0.18078E-04	0.13279E-04	0.650	0.31067E-04	0.16659E-03	0.30212E-03	0.43765E-03	0.31624E-03
-0.700	0.81538E-06	0.33231E-05	0.58308E-05	0.83385E-05	0.60921E-05	0.700	0.12688E-04	0.11033E-03	0.20798E-03	0.30562E-03	0.21815E-03
-0.750	0.33785E-06	0.14252E-05	0.25126E-05	0.36000E-05	0.26259E-05	0.750	0.53261E-05	0.76269E-04	0.14721E-03	0.21815E-03	0.15460E-03
-0.800	0.14330E-06	0.57549E-06	0.10077E-05	0.14399E-05	0.10527E-05	0.800	0.22803E-05	0.54021E-04	0.10576E-03	0.15750E-03	0.11115E-03
						0.850	0.99015E-06	0.38731E-04	0.76471E-04	0.11421E-03	0.80403E-04
						0.900	0.43426E-06	0.27882E-04	0.55329E-04	0.82776E-04	0.58189E-04
						0.950	0.19180E-06	0.20043E-04	0.39895E-04	0.59747E-04	0.41964E-04
						1.000	0.85129E-07	0.14333E-04	0.28581E-04	0.42828E-04	0.30065E-04
						1.050	0.37913E-07	0.10166E-04	0.20295E-04	0.30423E-04	0.21350E-04
						1.100	0.16925E-07	0.71371E-05	0.14257E-04	0.21378E-04	0.14999E-04
						1.150	0.75675E-08	0.49506E-05	0.98936E-05	0.14837E-04	0.10409E-04
						1.200	0.33875E-08	0.33881E-05	0.67728E-05	0.10157E-04	0.71255E-05

Figure 2-9 Maneuver Load Spectra: Single-Engine Special Usage

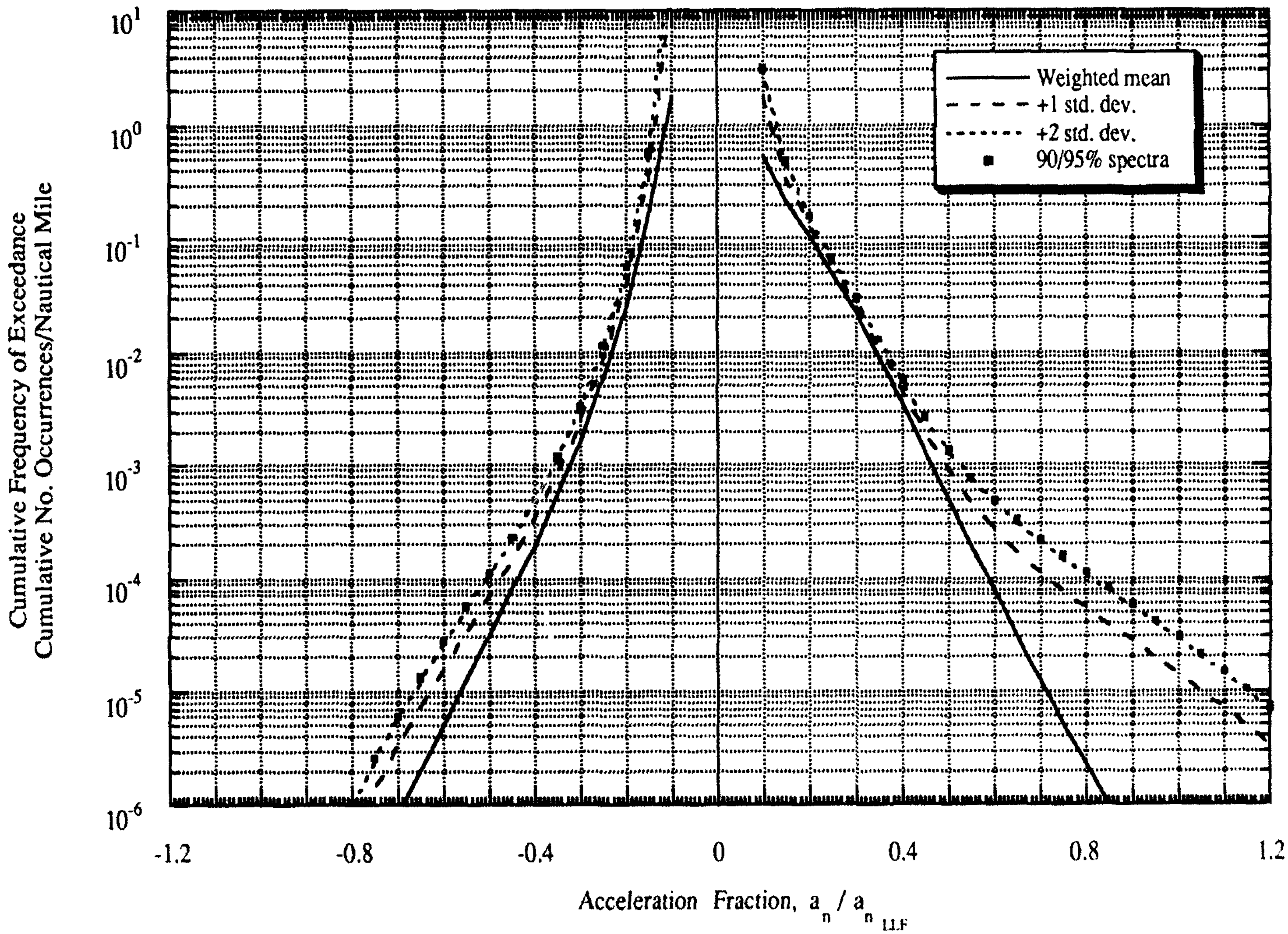


Table 2-10 Gust Load Spectra: Single-Engine Aerial Application

Accel. Fraction	Weighted mean	+1 std. dev.	+2 std. dev.	+3 std. dev.	90/95 % spectra	Accel. Fraction	Weighted mean	+1 std. dev.	+2 std. dev.	+3 std. dev.	90/95 % spectra
-0.200	0.78382E-01	0.23657E+00	0.39476E+00	0.55295E+00	0.33425E+00	0.200	0.19544E+00	0.65698E+00	0.11185E+01	0.15801E+01	0.94198E+00
-0.250	0.17210E-01	0.50712E-01	0.84215E-01	0.11772E+00	0.71399E-01	0.250	0.41523E-01	0.11422E+00	0.18692E+00	0.25961E+00	0.15911E+00
-0.300	0.48073E-02	0.14294E-01	0.23780E-01	0.33267E-01	0.20152E-01	0.300	0.12620E-01	0.29277E-01	0.45933E-01	0.62590E-01	0.39562E-01
-0.350	0.14737E-02	0.47495E-02	0.80252E-02	0.11301E-01	0.67722E-02	0.350	0.44364E-02	0.93767E-02	0.14317E-01	0.19257E-01	0.12427E-01
-0.400	0.47607E-03	0.17818E-02	0.30876E-02	0.43933E-02	0.25881E-02	0.400	0.16671E-02	0.34363E-02	0.52055E-02	0.69747E-02	0.45287E-02
-0.450	0.16634E-03	0.74624E-03	0.13261E-02	0.19060E-02	0.11043E-02	0.450	0.65154E-03	0.13829E-02	0.21143E-02	0.28456E-02	0.18345E-02
-0.500	0.64534E-04	0.34462E-03	0.62472E-03	0.90481E-03	0.51758E-03	0.500	0.26593E-03	0.60440E-03	0.94287E-03	0.12813E-02	0.81340E-03
-0.550	0.27301E-04	0.17191E-03	0.31652E-03	0.46114E-03	0.26121E-03	0.550	0.11449E-03	0.28606E-03	0.45762E-03	0.62918E-03	0.39199E-03
-0.600	0.12308E-04	0.91110E-04	0.16991E-03	0.24871E-03	0.13977E-03	0.600	0.52634E-04	0.14635E-03	0.24007E-03	0.33379E-03	0.20422E-03
-0.650	0.58920E-05	0.50777E-04	0.95661E-04	0.14055E-03	0.78492E-04	0.650	0.26068E-04	0.80568E-04	0.13507E-03	0.18957E-03	0.11422E-03
-0.700	0.30008E-05	0.29524E-04	0.56047E-04	0.82570E-04	0.45901E-04	0.700	0.13809E-04	0.47229E-04	0.80649E-04	0.11407E-03	0.67866E-04
-0.750	0.16277E-05	0.17791E-04	0.33954E-04	0.50117E-04	0.27771E-04	0.750	0.77407E-05	0.29188E-04	0.50635E-04	0.72083E-04	0.42431E-04
-0.800	0.93802E-06	0.11047E-04	0.21156E-04	0.31265E-04	0.17289E-04	0.800	0.45406E-05	0.18857E-04	0.33174E-04	0.47490E-04	0.27697E-04
-0.850	0.57068E-06	0.70344E-05	0.13498E-04	0.19962E-04	0.11026E-04	0.850	0.27664E-05	0.12657E-04	0.22548E-04	0.32439E-04	0.18765E-04
-0.900	0.36321E-06	0.45746E-05	0.87859E-05	0.12997E-04	0.71750E-05	0.900	0.17404E-05	0.87839E-05	0.15827E-04	0.22871E-04	0.13133E-04
-0.950	0.23945E-06	0.30278E-05	0.58161E-05	0.86045E-05	0.47496E-05	0.950	0.11250E-05	0.62771E-05	0.11429E-04	0.16581E-04	0.94584E-05
-1.000	0.16207E-06	0.20338E-05	0.39056E-05	0.57774E-05	0.31896E-05	1.000	0.74411E-06	0.46037E-05	0.84634E-05	0.12323E-04	0.69870E-05
-1.050	0.11178E-06	0.13832E-05	0.26546E-05	0.39260E-05	0.21683E-05	1.050	0.50185E-06	0.34558E-05	0.64097E-05	0.93636E-05	0.52798E-05
-1.100	0.78130E-07	0.95052E-06	0.18229E-05	0.26953E-05	0.14892E-05	1.100	0.34412E-06	0.26488E-05	0.49534E-05	0.72581E-05	0.40719E-05
-1.150	0.55117E-07	0.65891E-06	0.12627E-05	0.18665E-05	0.10317E-05	1.150	0.23932E-06	0.20689E-05	0.38986E-05	0.57282E-05	0.31987E-05
-1.200	0.39130E-07	0.46011E-06	0.88109E-06	0.13021E-05	0.72006E-06	1.200	0.16846E-06	0.16440E-05	0.31196E-05	0.45951E-05	0.25551E-05

Figure 2-10 Gust Load Spectra: Single-Engine Aerial Application

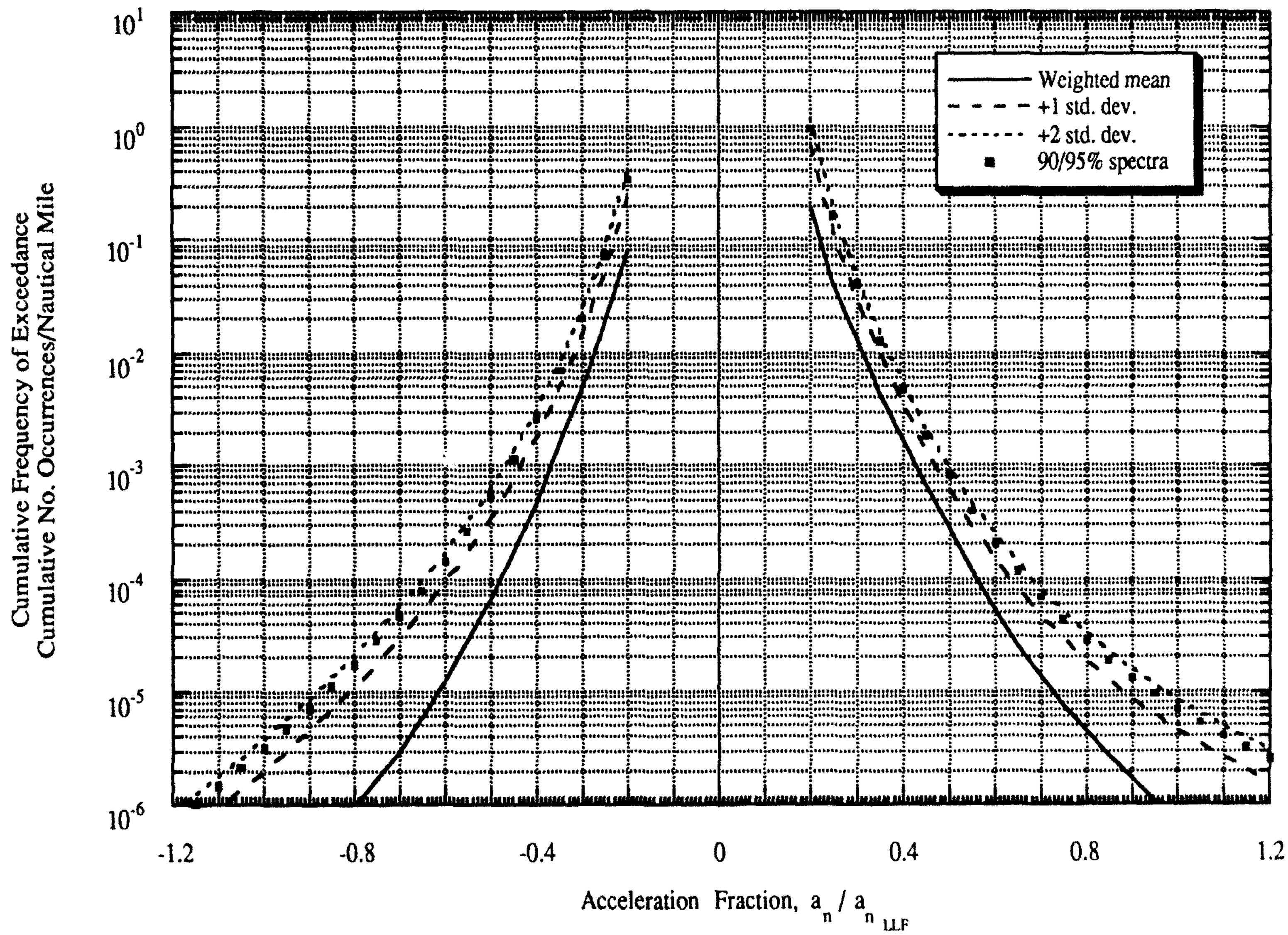


Table 2-11 Maneuver Load Spectra: Single-Engine Aerial Application

Accel. Fraction	Weighted mean	+1 std. dev.	+2 std. dev.	+3 std. dev.	90/95% spectra
-0.150	0.57901E+00	0.13093E+01	0.20397E+01	0.27700E+01	0.20612E+01
-0.200	0.37058E+00	0.86610E+00	0.13616E+01	0.18571E+01	0.13762E+01
-0.250	0.20569E+00	0.50727E+00	0.80885E+00	0.11104E+01	0.81774E+00
-0.300	0.98155E-01	0.26123E+00	0.42430E+00	0.58737E+00	0.42911E+00
-0.350	0.39905E-01	0.11760E+00	0.19530E+00	0.27300E+00	0.19759E+00
-0.400	0.14280E-01	0.47377E-01	0.80474E-01	0.11357E+00	0.81450E-01
-0.450	0.48008E-02	0.17349E-01	0.29897E-01	0.42445E-01	0.30267E-01
-0.500	0.15174E-02	0.57293E-02	0.99412E-02	0.14153E-01	0.10065E-01
-0.550	0.43806E-03	0.16945E-02	0.29509E-02	0.42073E-02	0.29879E-02
-0.600	0.11439E-03	0.44807E-03	0.78175E-03	0.11154E-02	0.79160E-03
-0.650	0.27099E-04	0.10610E-03	0.18510E-03	0.26410E-03	0.18743E-03
-0.700	0.58643E-05	0.22596E-04	0.39327E-04	0.56059E-04	0.39821E-04
-0.750	0.11797E-05	0.43973E-05	0.76149E-05	0.10833E-04	0.77098E-05
-0.800	0.23013E-06	0.82893E-06	0.14277E-05	0.20265E-05	0.14454E-05

Accel. Fraction	Weighted mean	+1 std. dev.	+2 std. dev.	+3 std. dev.	90/95% spectra
0.150	0.17258E+01	0.23245E+01	0.29232E+01	0.35220E+01	0.29409E+01
0.200	0.12697E+01	0.17692E+01	0.22687E+01	0.27682E+01	0.22834E+01
0.250	0.90694E+00	0.13168E+01	0.17267E+01	0.21365E+01	0.17388E+01
0.300	0.61841E+00	0.93649E+00	0.12546E+01	0.15726E+01	0.12639E+01
0.350	0.40125E+00	0.63617E+00	0.87109E+00	0.11060E+01	0.87802E+00
0.400	0.24791E+00	0.41305E+00	0.57819E+00	0.74334E+00	0.58307E+00
0.450	0.14615E+00	0.25669E+00	0.36722E+00	0.47775E+00	0.37048E+00
0.500	0.82451E-01	0.15307E+00	0.22369E+00	0.29431E+00	0.22578E+00
0.550	0.44660E-01	0.87874E-01	0.13109E+00	0.17430E+00	0.13236E+00
0.600	0.23315E-01	0.48708E-01	0.74101E-01	0.99495E-01	0.74851E-01
0.650	0.11780E-01	0.26133E-01	0.40485E-01	0.54838E-01	0.40909E-01
0.700	0.57865E-02	0.13602E-01	0.21417E-01	0.29232E-01	0.21647E-01
0.750	0.27773E-02	0.68891E-02	0.11001E-01	0.15113E-01	0.11122E-01
0.800	0.13094E-02	0.34131E-02	0.55169E-02	0.76207E-02	0.55790E-02
0.850	0.60998E-03	0.16681E-02	0.27261E-02	0.37842E-02	0.27574E-02
0.900	0.28272E-03	0.81367E-03	0.13446E-02	0.18756E-02	0.13603E-02
0.950	0.13135E-03	0.40105E-03	0.67075E-03	0.94045E-03	0.67870E-03
1.000	0.62073E-04	0.20237E-03	0.34267E-03	0.48296E-03	0.34681E-03
1.050	0.30043E-04	0.10432E-03	0.17860E-03	0.25288E-03	0.18079E-03
1.100	0.14802E-04	0.54326E-04	0.93849E-04	0.13337E-03	0.95015E-04
1.150	0.73808E-05	0.28352E-04	0.49323E-04	0.70294E-04	0.49942E-04
1.200	0.37051E-05	0.14754E-04	0.25803E-04	0.36852E-04	0.26129E-04

Figure 2-11 Maneuver Load Spectra: Single-Engine Aerial Application

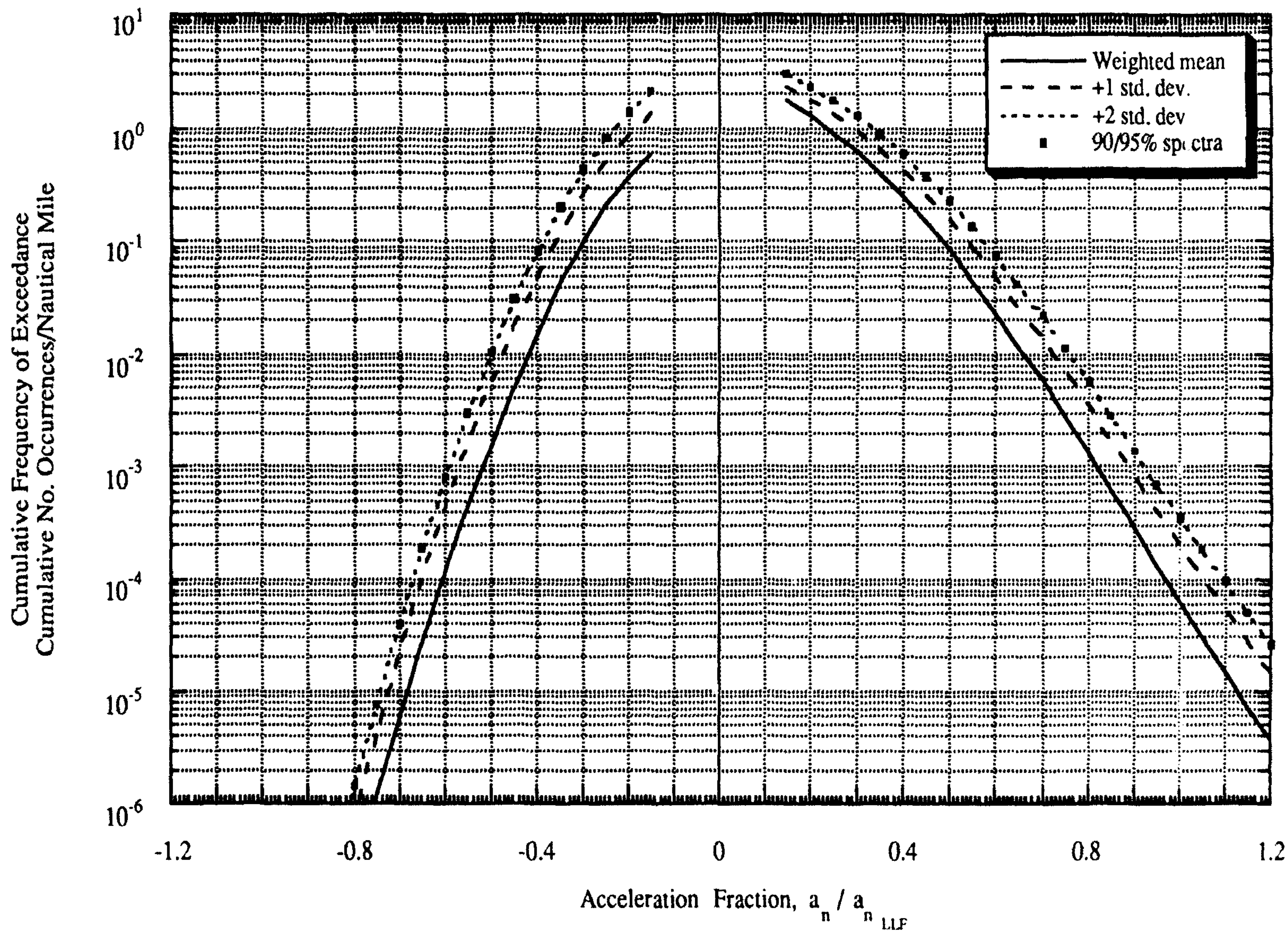


Table 2-12 Gust Load Spectra: Twin-Engine General Usage

Accel. Fraction	Weighted mean	+1 std. dev.	+2 std. dev.	+3 std. dev.	90/95% spectra	Accel. Fraction	Weighted mean	+1 std. dev.	+2 std. dev.	+3 std. dev.	90/95% spectra
-0.200	0.42370E-01	0.20056E+00	0.35875E+00	0.51694E+00	0.33712E+00	0.200	0.47889E-01	0.50943E+00	0.97098E+00	0.14325E+01	0.90788E+00
-0.250	0.11612E-01	0.45114E-01	0.78617E-01	0.11212E+00	0.74037E-01	0.250	0.12456E-01	0.85152E-01	0.15785E+00	0.23054E+00	0.14791E+00
-0.300	0.39171E-02	0.13404E-01	0.22890E-01	0.32377E-01	0.21593E-01	0.300	0.40849E-02	0.20741E-01	0.37398E-01	0.54054E-01	0.35121E-01
-0.350	0.15103E-02	0.47860E-02	0.80618E-02	0.11338E-01	0.76140E-02	0.350	0.15385E-02	0.64788E-02	0.11419E-01	0.16359E-01	0.10744E-01
-0.400	0.63876E-03	0.19445E-02	0.32502E-02	0.45560E-02	0.30717E-02	0.400	0.63540E-03	0.24046E-02	0.41738E-02	0.59430E-02	0.39319E-02
-0.450	0.28951E-03	0.86941E-03	0.14493E-02	0.20292E-02	0.13700E-02	0.450	0.28122E-03	0.10126E-02	0.17440E-02	0.24753E-02	0.16440E-02
-0.500	0.13876E-03	0.41885E-03	0.69894E-03	0.97903E-03	0.66065E-03	0.500	0.13224E-03	0.47071E-03	0.80918E-03	0.11476E-02	0.76291E-03
-0.550	0.69803E-04	0.21441E-03	0.35903E-03	0.50364E-03	0.33926E-03	0.550	0.66166E-04	0.23773E-03	0.40929E-03	0.58085E-03	0.38584E-03
-0.600	0.36720E-04	0.11552E-03	0.19432E-03	0.27313E-03	0.18355E-03	0.600	0.35485E-04	0.12920E-03	0.22292E-03	0.31664E-03	0.21011E-03
-0.650	0.20105E-04	0.64989E-04	0.10987E-03	0.15476E-03	0.10374E-03	0.650	0.20603E-04	0.75104E-04	0.12960E-03	0.18411E-03	0.12215E-03
-0.700	0.11402E-04	0.37925E-04	0.64448E-04	0.90971E-04	0.60822E-04	0.700	0.13067E-04	0.46487E-04	0.79908E-04	0.11333E-03	0.75339E-04
-0.750	0.66859E-05	0.22849E-04	0.39012E-04	0.55175E-04	0.36802E-04	0.750	0.90451E-05	0.30492E-04	0.51940E-04	0.73387E-04	0.49008E-04
-0.800	0.40228E-05	0.14132E-04	0.24241E-04	0.34350E-04	0.22859E-04	0.800	0.67392E-05	0.21056E-04	0.35372E-04	0.49689E-04	0.33415E-04
-0.850	0.24696E-05	0.89334E-05	0.15397E-04	0.21861E-04	0.14514E-04	0.850	0.52854E-05	0.15176E-04	0.25067E-04	0.34958E-04	0.23715E-04
-0.900	0.15483E-05	0.57597E-05	0.99710E-05	0.14182E-04	0.93953E-05	0.900	0.42828E-05	0.11326E-04	0.18370E-04	0.25413E-04	0.17407E-04
-0.950	0.99217E-06	0.37805E-05	0.65689E-05	0.93572E-05	0.61877E-05	0.950	0.35468E-05	0.86989E-05	0.13851E-04	0.19003E-04	0.13147E-04
-1.000	0.65040E-06	0.25222E-05	0.43939E-05	0.62657E-05	0.41381E-05	1.000	0.29800E-05	0.68396E-05	0.10699E-04	0.14559E-04	0.10172E-04
-1.050	0.43628E-06	0.17077E-05	0.29791E-05	0.42505E-05	0.28053E-05	1.050	0.25281E-05	0.54820E-05	0.84359E-05	0.11390E-04	0.80321E-05
-1.100	0.29937E-06	0.11718E-05	0.20441E-05	0.29165E-05	0.19249E-05	1.100	0.21591E-05	0.44637E-05	0.67684E-05	0.90730E-05	0.64533E-05
-1.150	0.20992E-06	0.81371E-06	0.14175E-05	0.20213E-05	0.13350E-05	1.150	0.18527E-05	0.36824E-05	0.55120E-05	0.73416E-05	0.52619E-05
-1.200	0.15017E-06	0.57115E-06	0.99214E-06	0.14131E-05	0.93459E-06	1.200	0.15955E-05	0.30711E-05	0.45466E-05	0.60222E-05	0.43449E-05

Figure 2-12 Gust Load Spectra: Twin-Engine General Usage

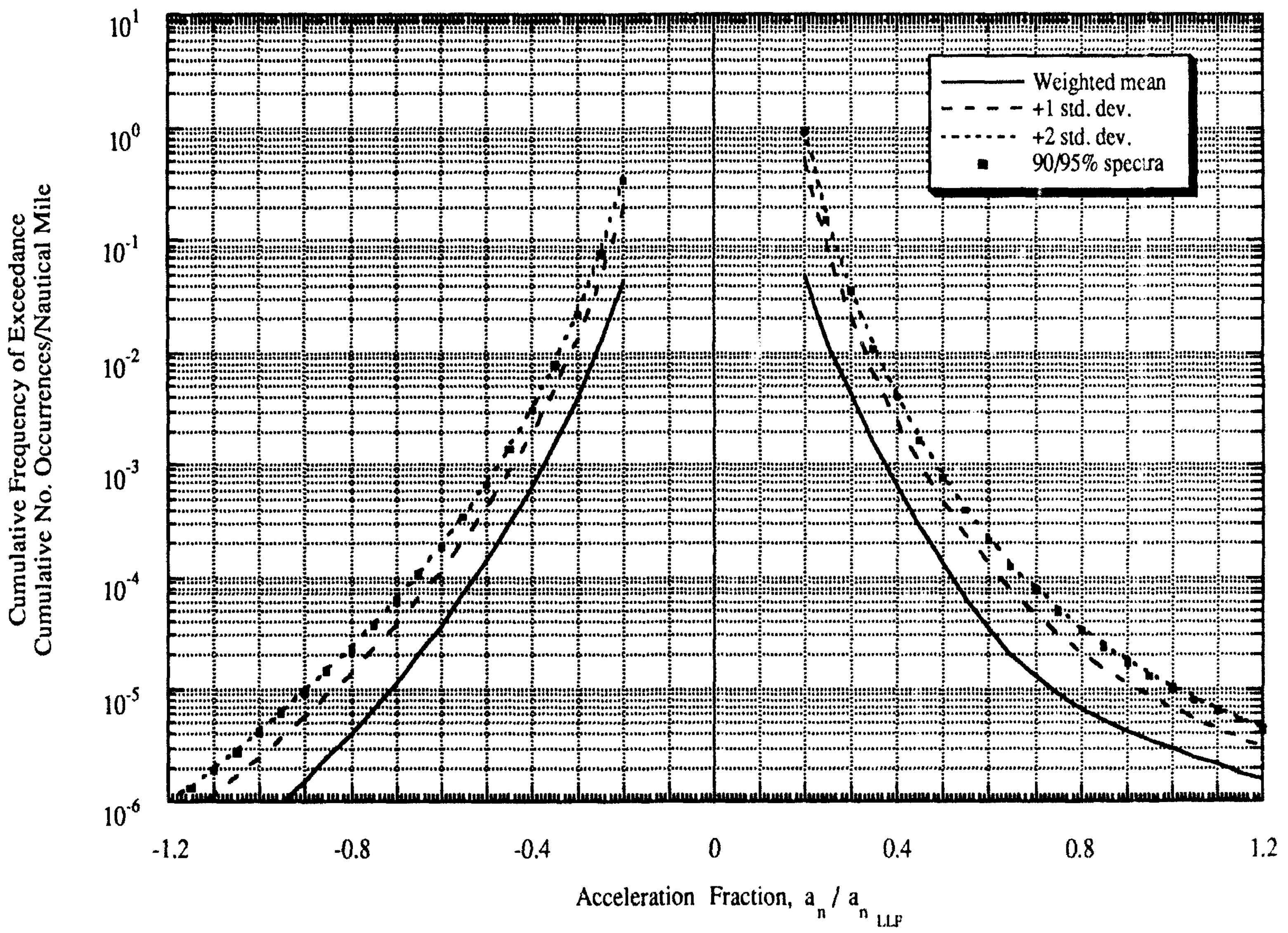


Table 2-13 Maneuver Load Spectra: Twin-Engine General Usage

Accel. Fraction	Weighted mean	+1 std. dev.	+2 std. dev.	+3 std. dev.	90/95 % spectra
-0.200	0.41795E-02	0.18584E-01	0.32989E-01	0.47393E-01	0.31020E-01
-0.250	0.10982E-02	0.36779E-02	0.62575E-02	0.88372E-02	0.59049E-02
-0.300	0.31095E-03	0.10690E-02	0.18271E-02	0.25852E-02	0.17235E-02
-0.350	0.87507E-04	0.38604E-03	0.68457E-03	0.98310E-03	0.64376E-03
-0.400	0.25232E-04	0.16482E-03	0.30441E-03	0.44400E-03	0.28533E-03
-0.450	0.79498E-05	0.79636E-04	0.15132E-03	0.22301E-03	0.14152E-03
-0.500	0.27717E-05	0.41109E-04	0.79446E-04	0.11778E-03	0.74205E-04
-0.550	0.10552E-05	0.21609E-04	0.42163E-04	0.62717E-04	0.39353E-04
-0.600	0.43014E-06	0.11172E-04	0.21914E-04	0.32656E-04	0.20446E-04
-0.650	0.18315E-06	0.55404E-05	0.10898E-04	0.16255E-04	0.10165E-04
-0.700	0.80135E-07	0.25878E-05	0.50955E-05	0.76032E-05	0.47527E-05
-0.750	0.35655E-07	0.11230E-05	0.22104E-05	0.32978E-05	0.20618E-05
-0.800	0.16028E-07	0.44821E-06	0.88040E-06	0.13126E-05	0.82132E-06

Accel. Fraction	Weighted mean	+1 std. dev.	+2 std. dev.	+3 std. dev.	90/95 % spectra
0.150	0.31391E-01	0.15138E+00	0.27137E+00	0.39137E+00	0.25497E+00
0.200	0.10128E-01	0.36201E-01	0.62275E-01	0.88349E-01	0.58711E-01
0.250	0.39709E-02	0.12562E-01	0.21153E-01	0.29744E-01	0.19978E-01
0.300	0.17331E-02	0.53804E-02	0.90277E-02	0.12675E-01	0.85291E-02
0.350	0.80276E-03	0.26320E-02	0.44613E-02	0.62905E-02	0.42112E-02
0.400	0.38384E-03	0.14129E-02	0.24419E-02	0.34709E-02	0.23012E-02
0.450	0.18658E-03	0.81453E-03	0.14425F-02	0.20704E-02	0.13566E-02
0.500	0.91679E-04	0.49797E-03	0.90426E-03	0.13105E-02	0.84871E-03
0.550	0.45682E-04	0.31990E-03	0.59412E-03	0.86833E-03	0.55663E-03
0.600	0.23391E-04	0.21415E-03	0.40490E-03	0.59566E-03	0.37883E-03
0.650	0.12619E-04	0.14815E-03	0.28367E-03	0.41920E-03	0.26515E-03
0.700	0.74435E-05	0.10509E-03	0.20273E-03	0.30038E-03	0.18938E-03
0.750	0.49126E-05	0.75855E-04	0.14680E-03	0.21774E-03	0.13710E-03
0.800	0.35732E-05	0.55314E-04	0.10705E-03	0.15879E-03	0.99981E-04
0.850	0.27927E-05	0.40533E-04	0.78273E-04	0.11601E-03	0.73114E-04
0.900	0.22870E-05	0.29734E-04	0.57182E-04	0.84629E-04	0.53430E-04
0.950	0.19257E-05	0.21777E-04	0.41629E-04	0.61481E-04	0.38915E-04
1.000	0.16475E-05	0.15895E-04	0.30143E-04	0.44391E-04	0.28195E-04
1.050	0.14220E-05	0.11550E-04	0.21679E-04	0.31807E-04	0.20294E-04
1.100	0.12334E-05	0.83536E-05	0.15474E-04	0.22594E-04	0.14500E-04
1.150	0.10727E-05	0.60157E-05	0.10959E-04	0.15902E-04	0.10283E-04
1.200	0.93430E-06	0.43190E-05	0.77037E-05	0.11088E-04	0.72410E-05

Figure 2-13 Maneuver Load Spectra: Twin-Engine General Usage

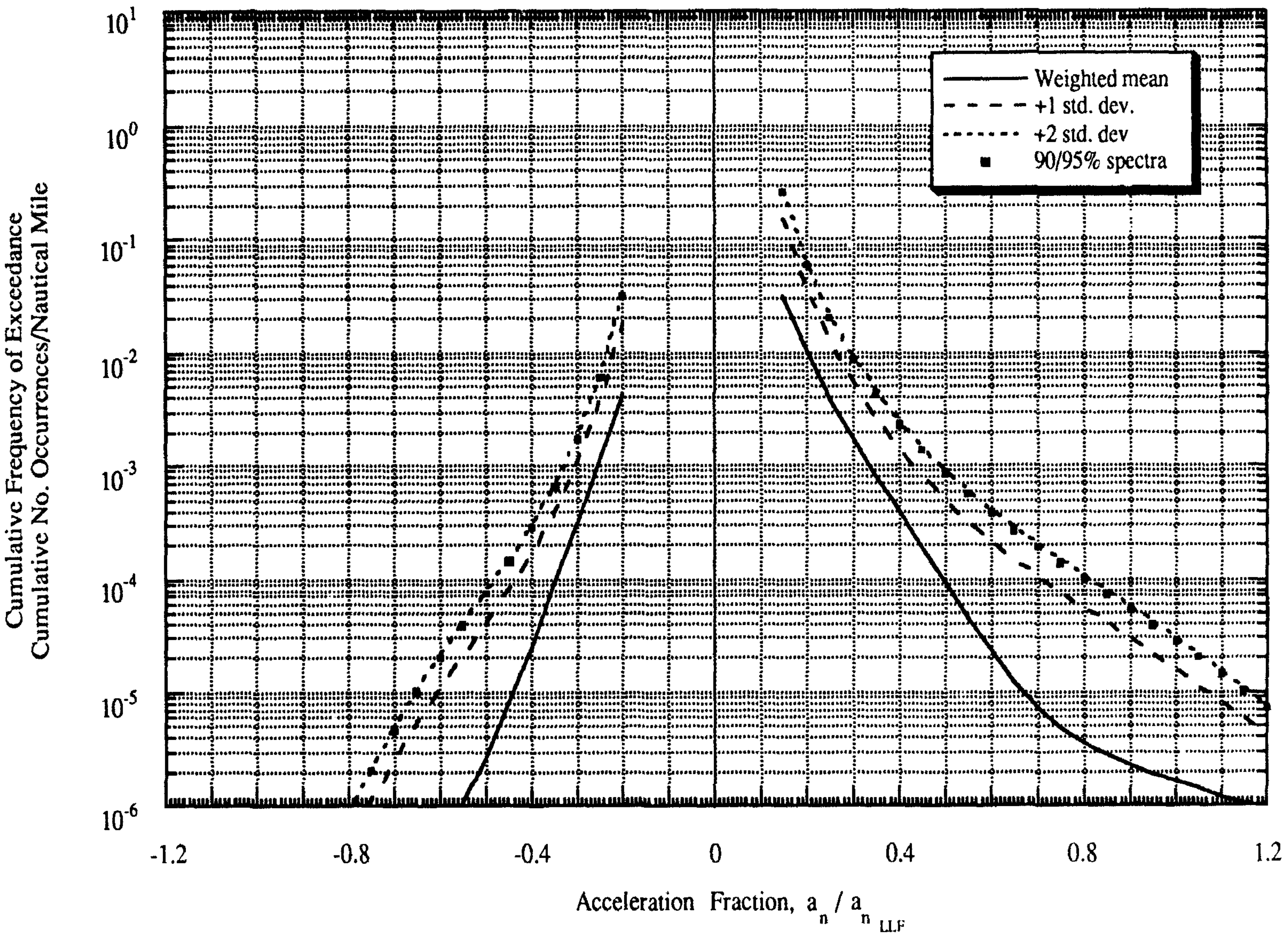


Table 2-14 Gust Load Spectra: Twin-Engine Special Usage

Accel. Fraction	Weighted mean	+1 std. dev.	+2 std. dev.	+3 std. dev.	90/95 % spectra	Accel. Fraction	Weighted mean	+1 std. dev.	+2 std. dev.	+3 std. dev.	90/95 % spectra
-0.150	0.65504E+00	0.18416E+01	0.30282E+01	0.42148E+01	0.33028E+01	0.150	0.10628E+01	0.63678E+01	0.11673E+02	0.16978E+02	0.12901E+02
-0.200	0.15489E+00	0.31308E+00	0.47127E+00	0.62946E+00	0.50788E+00	0.200	0.22734E+00	0.68889E+00	0.11504E+01	0.16120E+01	0.12573E+01
-0.250	0.44390E-01	0.77893E-01	0.11140E+00	0.14490E+00	0.11915E+00	0.250	0.63579E-01	0.13628E+00	0.20897E+00	0.28167E+00	0.22580E+00
-0.300	0.14444E-01	0.23931E-01	0.33417E-01	0.42904E-01	0.35613E-01	0.300	0.21139E-01	0.37796E-01	0.54452E-01	0.71109E-01	0.58307E-01
-0.350	0.53068E-02	0.85826E-02	0.11858E-01	0.15134E-01	0.12617E-01	0.350	0.80311E-02	0.12971E-01	0.17912E-01	0.22852E-01	0.19055E-01
-0.400	0.22193E-02	0.35250E-02	0.48308E-02	0.61365E-02	0.51330E-02	0.400	0.34062E-02	0.51754E-02	0.69446E-02	0.87138E-02	0.73541E-02
-0.450	0.10474E-02	0.16273E-02	0.22072E-02	0.27871E-02	0.23414E-02	0.450	0.15780E-02	0.23093E-02	0.30407E-02	0.37721E-02	0.32100E-02
-0.500	0.54297E-03	0.82306E-03	0.11031E-02	0.13832E-02	0.11680E-02	0.500	0.78093E-03	0.11194E-02	0.14579E-02	0.17963E-02	0.15362E-02
-0.550	0.29926E-03	0.44387E-03	0.58848E-03	0.73309E-03	0.62195E-03	0.550	0.40432E-03	0.57588E-03	0.74744E-03	0.91901E-03	0.78715E-03
-0.600	0.17146E-03	0.25026E-03	0.32906E-03	0.40787E-03	0.34730E-03	0.600	0.21530E-03	0.30902E-03	0.40274E-03	0.49646E-03	0.42443E-03
-0.650	0.10086E-03	0.14575E-03	0.19063E-03	0.23552E-03	0.20102E-03	0.650	0.11634E-03	0.17084E-03	0.22534E-03	0.27984E-03	0.23796E-03
-0.700	0.60468E-04	0.86991E-04	0.11351E-03	0.14004E-03	0.11965E-03	0.700	0.63204E-04	0.96625E-04	0.13005E-03	0.16347E-03	0.13778E-03
-0.750	0.36767E-04	0.52930E-04	0.69093E-04	0.85256E-04	0.72834E-04	0.750	0.34319E-04	0.55767E-04	0.77214E-04	0.98661E-04	0.82178E-04
-0.800	0.22594E-04	0.32703E-04	0.42812E-04	0.52921E-04	0.45152E-04	0.800	0.18554E-04	0.32870E-04	0.47187E-04	0.61503E-04	0.50500E-04
-0.850	0.13945E-04	0.20409E-04	0.26873E-04	0.33336E-04	0.28369E-04	0.850	0.10001E-04	0.19892E-04	0.29783E-04	0.39674E-04	0.32072E-04
-0.900	0.86073E-05	0.12819E-04	0.17030E-04	0.21241E-04	0.18005E-04	0.900	0.53918E-05	0.12435E-04	0.19479E-04	0.26522E-04	0.21109E-04
-0.950	0.53126E-05	0.81010E-05	0.10889E-04	0.13678E-04	0.11535E-04	0.950	0.29073E-05	0.80594E-05	0.13211E-04	0.18364E-04	0.14404E-04
-1.000	0.32791E-05	0.51509E-05	0.70226E-05	0.88944E-05	0.74558E-05	1.000	0.15678E-05	0.54274E-05	0.92870E-05	0.13147E-04	0.10180E-04
-1.050	0.20239E-05	0.32953E-05	0.45668E-05	0.58382E-05	0.48610E-05	1.050	0.84543E-06	0.37993E-05	0.67533E-05	0.97072E-05	0.74369E-05
-1.100	0.12492E-05	0.21216E-05	0.29940E-05	0.38664E-05	0.31959E-05	1.100	0.45591E-06	0.27606E-05	0.50652E-05	0.73699E-05	0.55986E-05
-1.150	0.77105E-06	0.13748E-05	0.19786E-05	0.25824E-05	0.21184E-05	1.150	0.24586E-06	0.20755E-05	0.39051E-05	0.57347E-05	0.43285E-05
-1.200	0.47591E-06	0.89690E-06	0.13179E-05	0.17389E-05	0.14153E-05	1.200	0.13259E-06	0.16081E-05	0.30837E-05	0.45592E-05	0.34252E-05

Figure 2-14 Gust Load Spectra: Twin-Engine Special Usage

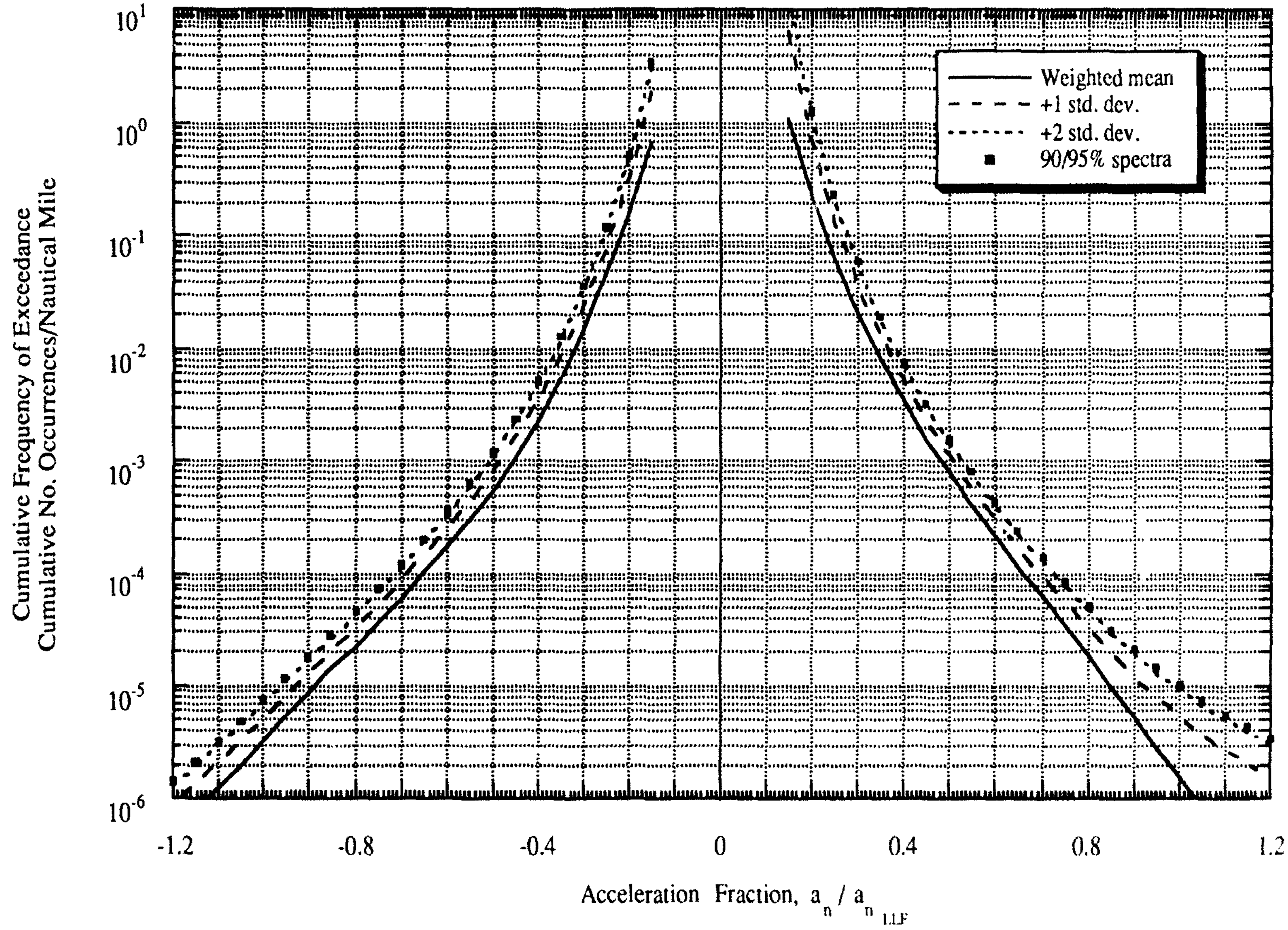


Table 2-15 Maneuver Load Spectra: Twin-Engine Special Usage

Accel. Fraction	Weighted mean	+1 std. dev.	+2 std. dev.	+3 std. dev.	90/95 % spectra
-0.100	0.49571E+00	0.15041E+02	0.29587E+02	0.44132E+02	0.32953E+02
-0.150	0.34857E-01	0.22781E+00	0.42077E+00	0.61373E+00	0.46543E+00
-0.200	0.41399E-02	0.18545E-01	0.32949E-01	0.47354E-01	0.36283E-01
-0.250	0.61398E-03	0.31937E-02	0.57733E-02	0.83530E-02	0.63704E-02
-0.300	0.99326E-04	0.85742E-03	0.16155E-02	0.23736E-02	0.17910E-02
-0.350	0.16375E-04	0.31490E-03	0.61343E-03	0.91196E-03	0.68253E-03
-0.400	0.27187E-05	0.14231E-03	0.28190E-03	0.42149E-03	0.31420E-03
-0.450	0.46128E-06	0.72148E-04	0.14383E-03	0.21552E-03	0.16043E-03
-0.500	0.80534E-07	0.38418E-04	0.76755E-04	0.11509E-03	0.85627E-04
-0.550	0.14571E-07	0.20568E-04	0.41122E-04	0.61676E-04	0.45879E-04
-0.600	0.27485E-08	0.10745E-04	0.21487E-04	0.32229E-04	0.23973E-04
-0.650	0.54215E-09	0.53578E-05	0.10715E-04	0.16072E-04	0.11955E-04
-0.700	0.11177E-09	0.25078E-05	0.50155E-05	0.75232E-05	0.55959E-05
-0.750	0.23984E-10	0.10874E-05	0.21748E-05	0.32622E-05	0.24265E-05
-0.800	0.53217E-11	0.43219E-06	0.86438E-06	0.12966E-05	0.96440E-06

Accel. Fraction	Weighted mean	+1 std. dev.	+2 std. dev.	+3 std. dev.	90/95 % spectra
0.150	0.74754E-01	0.19475E+00	0.31474E+00	0.43473E+00	0.34251E+00
0.200	0.37208E-01	0.63282E-01	0.89355E-01	0.11543E+00	0.95390E-01
0.250	0.19583E-01	0.28174E-01	0.36765E-01	0.45356E-01	0.38754E-01
0.300	0.99688E-02	0.13616E-01	0.17263E-01	0.20911E-01	0.18108E-01
0.350	0.47513E-02	0.65806E-02	0.84098E-02	0.10239E-01	0.88332E-02
0.400	0.20968E-02	0.31258E-02	0.41548E-02	0.51839E-02	0.43930E-02
0.450	0.85609E-03	0.14840E-02	0.21120E-02	0.27399E-02	0.22573E-02
0.500	0.32588E-03	0.73217E-03	0.11385E-02	0.15447E-02	0.12325E-02
0.550	0.11758E-03	0.39179E-03	0.66601E-03	0.94023E-03	0.72948E-03
0.600	0.41548E-04	0.23230E-03	0.42306E-03	0.61382E-03	0.46721E-03
0.650	0.15473E-04	0.15100E-03	0.28653E-03	0.42205E-03	0.31789E-03
0.700	0.63116E-05	0.10396E-03	0.20160E-03	0.29925E-03	0.22420E-03
0.750	0.27831E-05	0.73726E-04	0.14467E-03	0.21561E-03	0.16109E-03
0.800	0.12996E-05	0.53040E-04	0.10478E-03	0.15652E-03	0.11676E-03
0.850	0.63010E-06	0.38370E-04	0.76111E-04	0.11385E-03	0.84846E-04
0.900	0.31255E-06	0.27760E-04	0.55207E-04	0.82655E-04	0.61560E-04
0.950	0.15709E-06	0.20009E-04	0.39860E-04	0.59712E-04	0.44455E-04
1.000	0.79544E-07	0.14327E-04	0.28575E-04	0.42823E-04	0.31873E-04
1.050	0.40443E-07	0.10169E-04	0.20297E-04	0.30426E-04	0.22641E-04
1.100	0.20609E-07	0.71408E-05	0.14261E-04	0.21381E-04	0.15909E-04
1.150	0.10515E-07	0.49535E-05	0.98966E-05	0.14840E-04	0.11041E-04
1.200	0.53683E-08	0.33901E-05	0.67748E-05	0.10159E-04	0.75581E-05

Figure 2-15 Maneuver Load Spectra: Twin-Engine Special Usage

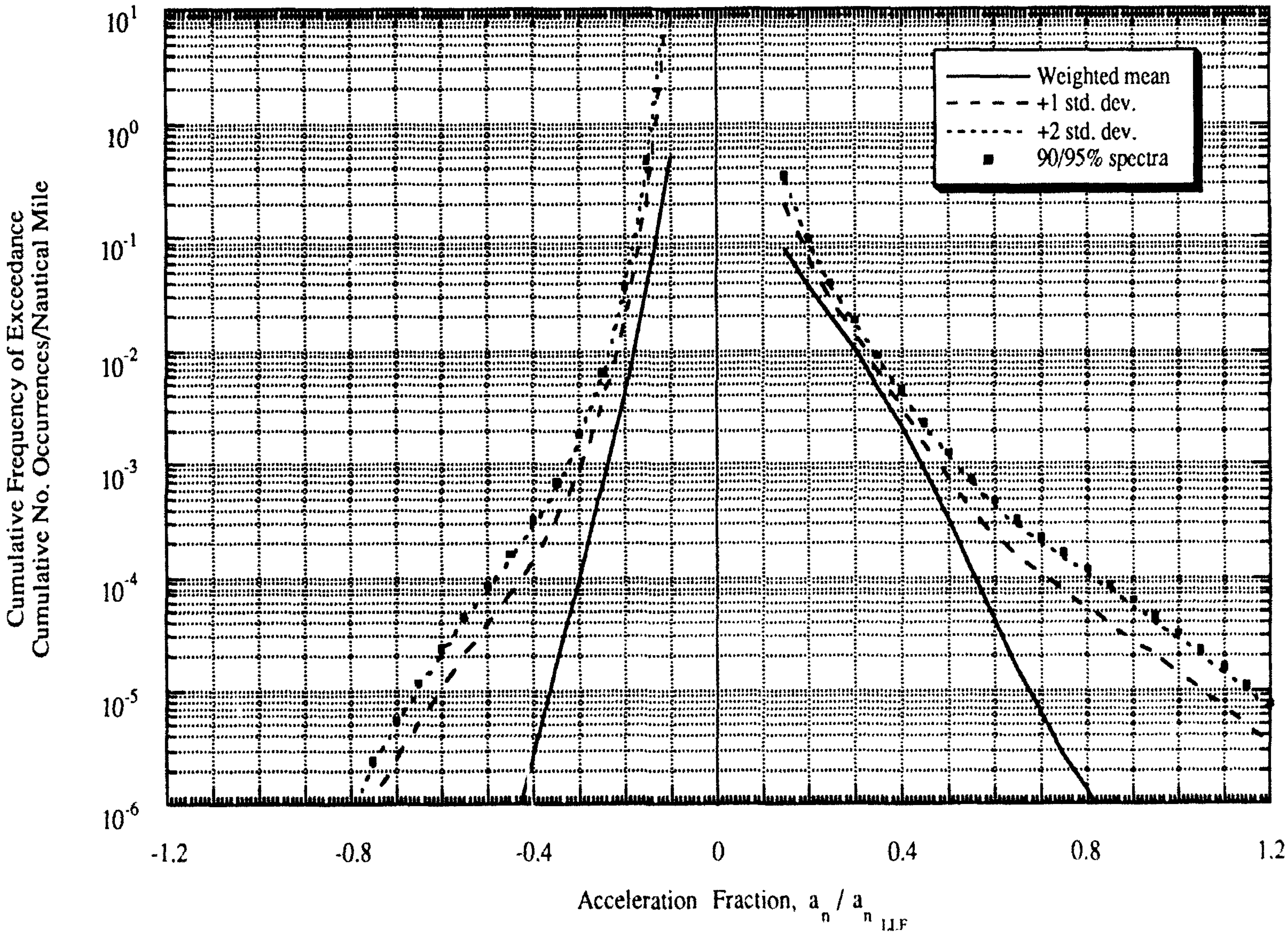


Table 2-16 Gust Load Spectra: Single and Twin-Engine Special Usage

Accel. Fraction	Weighted mean	+1 std. dev.	+2 std. dev.	+3 std. dev.	90/95% spectra	Accel. Fraction	Weighted mean	+1 std. dev.	+2 std. dev.	+3 std. dev.	90/95% spectra
-0.150	0.23865E+01	0.35731E+01	0.47597E+01	0.59463E+01	0.46451E+01	0.150	0.30838E+01	0.83888E+01	0.13694E+02	0.18999E+02	0.13182E+02
-0.200	0.46135E+00	0.61953E+00	0.77772E+00	0.93591E+00	0.76245E+00	0.200	0.46895E+00	0.93050E+00	0.13920E+01	0.18536E+01	0.13475E+01
-0.250	0.12163E+00	0.15513E+00	0.18864E+00	0.22214E+00	0.18540E+00	0.250	0.10650E+00	0.17920E+00	0.25189E+00	0.32459E+00	0.24487E+00
-0.300	0.38501E-01	0.47988E-01	0.57474E-01	0.66961E-01	0.56558E-01	0.300	0.31305E-01	0.47962E-01	0.64618E-01	0.81275E-01	0.63010E-01
-0.350	0.13740E-01	0.17016E-01	0.20291E-01	0.23567E-01	0.19975E-01	0.350	0.11082E-01	0.16022E-01	0.20962E-01	0.25902E-01	0.20485E-01
-0.400	0.53427E-02	0.66484E-02	0.79542E-02	0.92599E-02	0.78281E-02	0.400	0.45192E-02	0.62884E-02	0.80576E-02	0.98268E-02	0.78868E-02
-0.450	0.22182E-02	0.27981E-02	0.33780E-02	0.39579E-02	0.33220E-02	0.450	0.20530E-02	0.27844E-02	0.35158E-02	0.42472E-02	0.34452E-02
-0.500	0.97076E-03	0.12509E-02	0.15309E-02	0.18110E-02	0.15039E-02	0.500	0.10104E-02	0.13489E-02	0.16873E-02	0.20258E-02	0.16546E-02
-0.550	0.44385E-03	0.58846E-03	0.73307E-03	0.87768E-03	0.71911E-03	0.550	0.52651E-03	0.69807E-03	0.86963E-03	0.10412E-02	0.85307E-03
-0.600	0.21078E-03	0.28958E-03	0.36838E-03	0.44718E-03	0.36077E-03	0.600	0.28547E-03	0.37918E-03	0.47290E-03	0.56662E-03	0.46385E-03
-0.650	0.10359E-03	0.14847E-03	0.19336E-03	0.23824E-03	0.18902E-03	0.650	0.15902E-03	0.21352E-03	0.26802E-03	0.32252E-03	0.26276E-03
-0.700	0.52521E-04	0.79044E-04	0.10557E-03	0.13209E-03	0.10301E-03	0.700	0.90102E-04	0.12352E-03	0.15694E-03	0.19036E-03	0.15372E-03
-0.750	0.27390E-04	0.43553E-04	0.59717E-04	0.75880E-04	0.58156E-04	0.750	0.51559E-04	0.73006E-04	0.94453E-04	0.11590E-03	0.92383E-04
-0.800	0.14667E-04	0.24776E-04	0.34885E-04	0.44994E-04	0.33909E-04	0.800	0.29674E-04	0.43991E-04	0.58307E-04	0.72624E-04	0.56925E-04
-0.850	0.80317E-05	0.14495E-04	0.20959E-04	0.27423E-04	0.20335E-04	0.850	0.17140E-04	0.27031E-04	0.36922E-04	0.46813E-04	0.35967E-04
-0.900	0.44744E-05	0.86858E-05	0.12897E-04	0.17109E-04	0.12491E-04	0.900	0.99222E-05	0.16966E-04	0.24009E-04	0.31053E-04	0.23329E-04
-0.950	0.25287E-05	0.53171E-05	0.81054E-05	0.10894E-04	0.78362E-05	0.950	0.57538E-05	0.10906E-04	0.16058E-04	0.21210E-04	0.15561E-04
-1.000	0.14465E-05	0.33183E-05	0.51900E-05	0.70618E-05	0.50093E-05	1.000	0.33421E-05	0.72017E-05	0.11061E-04	0.14921E-04	0.10689E-04
-1.050	0.83593E-06	0.21073E-05	0.33787E-05	0.46502E-05	0.32560E-05	1.050	0.19443E-05	0.48982E-05	0.78521E-05	0.10806E-04	0.75669E-05
-1.100	0.48727E-06	0.13597E-05	0.22320E-05	0.31044E-05	0.21478E-05	1.100	0.11328E-05	0.34375E-05	0.57422E-05	0.80468E-05	0.55196E-05
-1.150	0.28612E-06	0.88992E-06	0.14937E-05	0.20975E-05	0.14354E-05	1.150	0.66106E-06	0.24907E-05	0.43203E-05	0.61499E-05	0.41436E-05
-1.200	0.16907E-06	0.59005E-06	0.10110E-05	0.14320E-05	0.97039E-06	1.200	0.38633E-06	0.18619E-05	0.33374E-05	0.48130E-05	0.31950E-05

Figure 2-16 Gust Load Spectra: Single and Twin-Engine Special Usage

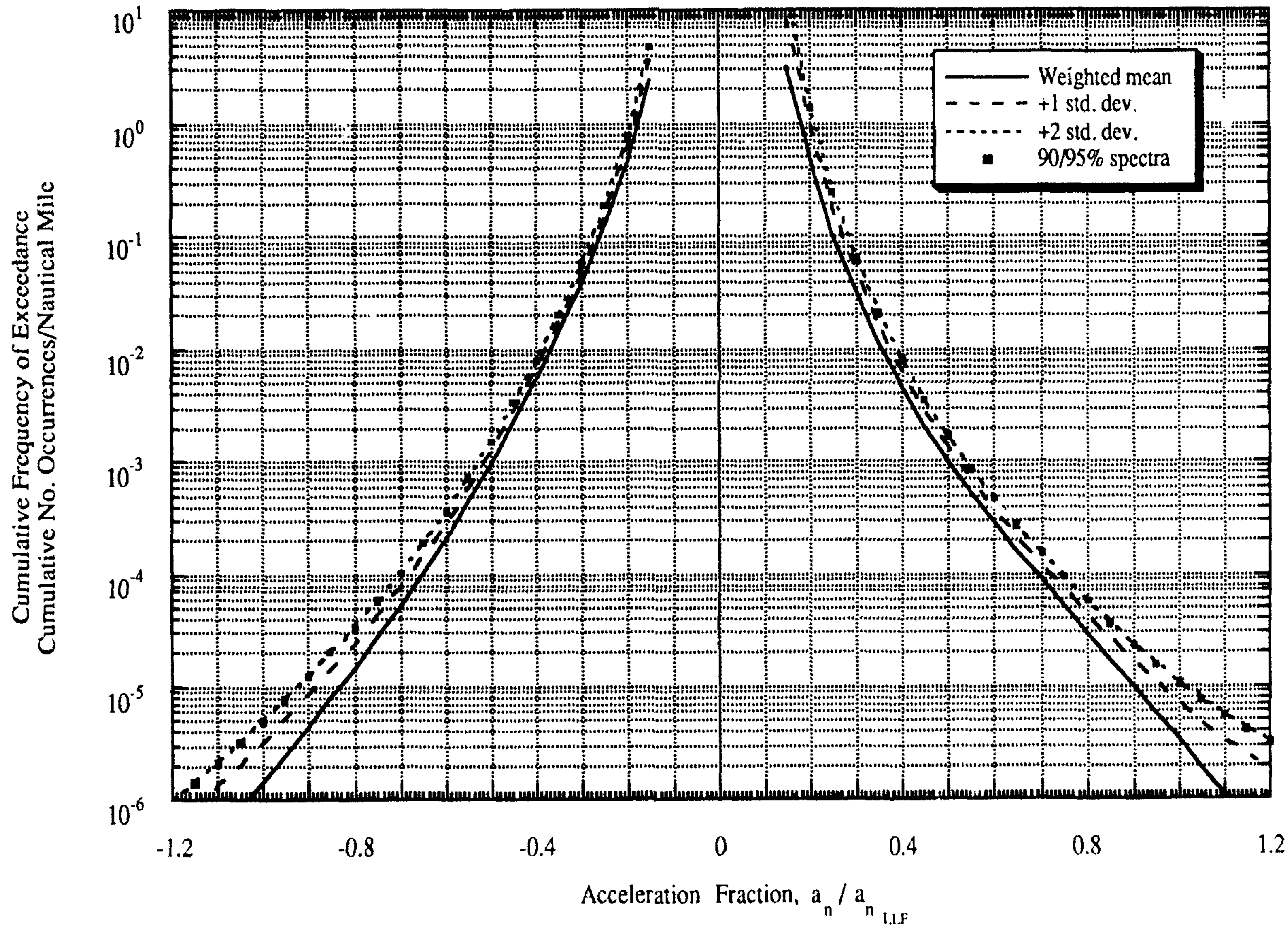


Table 2-17 Maneuver Load Spectra: Single and Twin-Engine Special Usage

Accel. Fraction	Weighted mean	+1 std. dev.	+2 std. dev.	+3 std. dev.	90/95% spectra
-0.100	0.14450E+01	0.15991E+02	0.30536E+02	0.45082E+02	0.29132E+02
-0.150	0.12207E+00	0.31503E+00	0.50798E+00	0.70094E+00	0.48935E+00
-0.200	0.19716E-01	0.34121E-01	0.48525E-01	0.62930E-01	0.47134E-01
-0.250	0.44568E-02	0.70365E-02	0.96162E-02	0.12196E-01	0.93671E-02
-0.300	0.12389E-02	0.19970E-02	0.27551E-02	0.35132E-02	0.26819E-02
-0.350	0.39786E-03	0.69639E-03	0.99492E-03	0.12934E-02	0.96610E-03
-0.400	0.14320E-03	0.28279E-03	0.42238E-03	0.56197E-03	0.40890E-03
-0.450	0.56351E-04	0.12804E-03	0.19972E-03	0.27141E-03	0.19280E-03
-0.500	0.23212E-04	0.61549E-04	0.99886E-04	0.13822E-03	0.96185E-04
-0.550	0.93841E-05	0.29938E-04	0.50492E-04	0.71046E-04	0.48507E-04
-0.600	0.37075E-05	0.14449E-04	0.25192E-04	0.35934E-04	0.24154E-04
-0.650	0.14832E-05	0.68405E-05	0.12198E-04	0.17555E-04	0.11681E-04
-0.700	0.60277E-06	0.31105E-05	0.56182E-05	0.81259E-05	0.53761E-05
-0.750	0.24975E-06	0.13371E-05	0.24245E-05	0.35119E-05	0.23195E-05
-0.800	0.10593E-06	0.53812E-06	0.97031E-06	0.14025E-05	0.92858E-06

Accel. Fraction	Weighted mean	+1 std. dev.	+2 std. dev.	+3 std. dev.	90/95% spectra
0.100	0.44303E+00	0.16498E+01	0.28566E+01	0.40634E+01	0.27401E+01
0.150	0.17647E+00	0.29646E+00	0.41645E+00	0.53645E+00	0.40487E+00
0.200	0.85140E-01	0.11121E+00	0.13729E+00	0.16336E+00	0.13477E+00
0.250	0.41079E-01	0.49670E-01	0.58261E-01	0.66852E-01	0.57432E-01
0.300	0.18585E-01	0.22232E-01	0.25880E-01	0.29527E-01	0.25528E-01
0.350	0.77958E-02	0.96250E-02	0.11454E-01	0.13284E-01	0.11278E-01
0.400	0.30769E-02	0.41060E-02	0.51350E-02	0.61640E-02	0.50356E-02
0.450	0.11750E-02	0.18029E-02	0.24309E-02	0.30588E-02	0.23702E-02
0.500	0.44681E-03	0.85310E-03	0.12594E-02	0.16657E-02	0.12202E-02
0.550	0.17229E-03	0.44650E-03	0.72072E-03	0.99494E-03	0.69424E-03
0.600	0.67747E-04	0.25850E-03	0.44926E-03	0.64002E-03	0.43084E-03
0.650	0.27000E-04	0.16253E-03	0.29805E-03	0.43358E-03	0.28497E-03
0.700	0.11025E-04	0.10867E-03	0.20631E-03	0.30396E-03	0.19689E-03
0.750	0.46629E-05	0.75606E-04	0.14655E-03	0.21749E-03	0.13970E-03
0.800	0.20245E-05	0.53765E-04	0.10551E-03	0.15725E-03	0.10051E-03
0.850	0.89625E-06	0.38637E-04	0.76377E-04	0.11412E-03	0.72733E-04
0.900	0.40252E-06	0.27850E-04	0.55297E-04	0.82745E-04	0.52647E-04
0.950	0.18275E-06	0.20034E-04	0.39886E-04	0.59738E-04	0.37969E-04
1.000	0.83673E-07	0.14331E-04	0.28579E-04	0.42827E-04	0.27204E-04
1.050	0.38573E-07	0.10167E-04	0.20295E-04	0.30424E-04	0.19318E-04
1.100	0.17885E-07	0.71381E-05	0.14258E-04	0.21379E-04	0.13571E-04
1.150	0.83361E-08	0.49514E-05	0.98944E-05	0.14837E-04	0.94172E-05
1.200	0.39041E-08	0.33886E-05	0.67733E-05	0.10158E-04	0.64465E-05

Figure 2-17 Maneuver Load Spectra: Single and Twin-Engine Special Usage

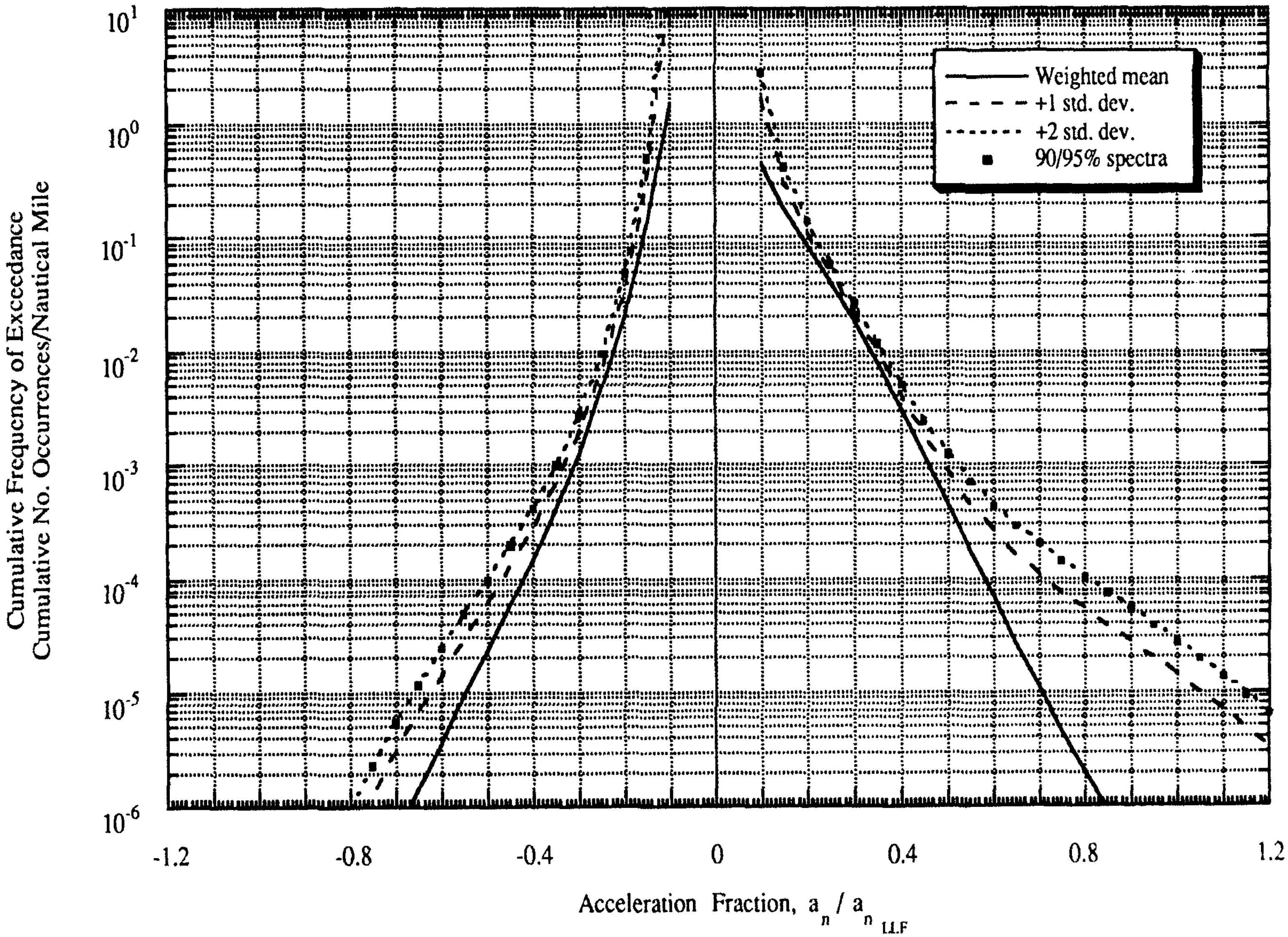


Table 2-18 Gust Load Spectra: Single and Twin-Engine Pressurized General Usage

Accel. Fraction	Weighted mean	+1 std. dev.	+2 std. dev.	+3 std. dev.	90/95% spectra	Accel. Fraction	Weighted mean	+1 std. dev.	+2 std. dev.	+3 std. dev.	90/95% spectra
-0.200	0.10535E-01	0.16872E+00	0.32691E+00	0.48510E+00	0.36352E+00	0.200	0.13600E-01	0.47515E+00	0.93669E+00	0.13982E+01	0.10435E+01
-0.250	0.33603E-02	0.36863E-01	0.70365E-01	0.10387E+00	0.78119E-01	0.250	0.37495E-02	0.76446E-01	0.14914E+00	0.22184E+00	0.16597E+00
-0.300	0.12185E-02	0.10705E-01	0.20191E-01	0.29678E-01	0.22387E-01	0.300	0.12117E-02	0.17868E-01	0.34525E-01	0.51181E-01	0.38380E-01
-0.350	0.47009E-03	0.37459E-02	0.70216E-02	0.10297E-01	0.77798E-02	0.350	0.43063E-03	0.53709E-02	0.10311E-01	0.15252E-01	0.11455E-01
-0.400	0.18687E-03	0.14926E-02	0.27984E-02	0.41041E-02	0.31006E-02	0.400	0.16609E-03	0.19353E-02	0.37045E-02	0.54737E-02	0.41139E-02
-0.450	0.75480E-04	0.65538E-03	0.12353E-02	0.18152E-02	0.13695E-02	0.450	0.69962E-04	0.80133E-03	0.15327E-02	0.22641E-02	0.17020E-02
-0.500	0.30901E-04	0.31099E-03	0.59108E-03	0.87117E-03	0.65591E-03	0.500	0.32396E-04	0.37087E-03	0.70934E-03	0.10478E-02	0.78767E-03
-0.550	0.12872E-04	0.15748E-03	0.30210E-03	0.44671E-03	0.33556E-03	0.550	0.16189E-04	0.18775E-03	0.35931E-03	0.53087E-03	0.39902E-03
-0.600	0.55147E-05	0.84317E-04	0.16312E-03	0.24192E-03	0.18136E-03	0.600	0.85120E-05	0.10223E-03	0.19595E-03	0.28967E-03	0.21764E-03
-0.650	0.24398E-05	0.47325E-04	0.92209E-04	0.13709E-03	0.10260E-03	0.650	0.45857E-05	0.59086E-04	0.11359E-03	0.16809E-03	0.12620E-03
-0.700	0.11108E-05	0.27634E-04	0.54157E-04	0.80680E-04	0.60295E-04	0.700	0.24834E-05	0.35904E-04	0.69324E-04	0.10274E-03	0.77059E-04
-0.750	0.51808E-06	0.16681E-04	0.32844E-04	0.49007E-04	0.36585E-04	0.750	0.13484E-05	0.22796E-04	0.44243E-04	0.65690E-04	0.49207E-04
-0.800	0.24644E-06	0.10356E-04	0.20465E-04	0.30574E-04	0.22804E-04	0.800	0.73310E-06	0.15050E-04	0.29366E-04	0.43683E-04	0.32680E-04
-0.850	0.11905E-06	0.65828E-05	0.13047E-04	0.19510E-04	0.14543E-04	0.850	0.39891E-06	0.10290E-04	0.20181E-04	0.30072E-04	0.22470E-04
-0.900	0.58198E-07	0.42696E-05	0.84809E-05	0.12692E-04	0.94556E-05	0.900	0.21718E-06	0.72607E-05	0.14304E-04	0.21348E-04	0.15934E-04
-0.950	0.28709E-07	0.28171E-05	0.56054E-05	0.83938E-05	0.62507E-05	0.950	0.11829E-06	0.52704E-05	0.10422E-04	0.15574E-04	0.11615E-04
-1.000	0.14259E-07	0.18860E-05	0.37578E-05	0.56296E-05	0.41910E-05	1.000	0.64447E-07	0.39241E-05	0.77837E-05	0.11643E-04	0.86770E-05
-1.050	0.71191E-08	0.12785E-05	0.25499E-05	0.38213E-05	0.28442E-05						
-1.100	0.35686E-08	0.87596E-06	0.17483E-05	0.26207E-05	0.19502E-05						
-1.150	0.17944E-08	0.60559E-06	0.12094E-05	0.18132E-05	0.13491E-05						
-1.200	0.90453E-09	0.42189E-06	0.84287E-06	0.12638E-05	0.94030E-06						

Figure 2-18 Gust Load Spectra: Single and Twin-Engine Pressurized General Usage

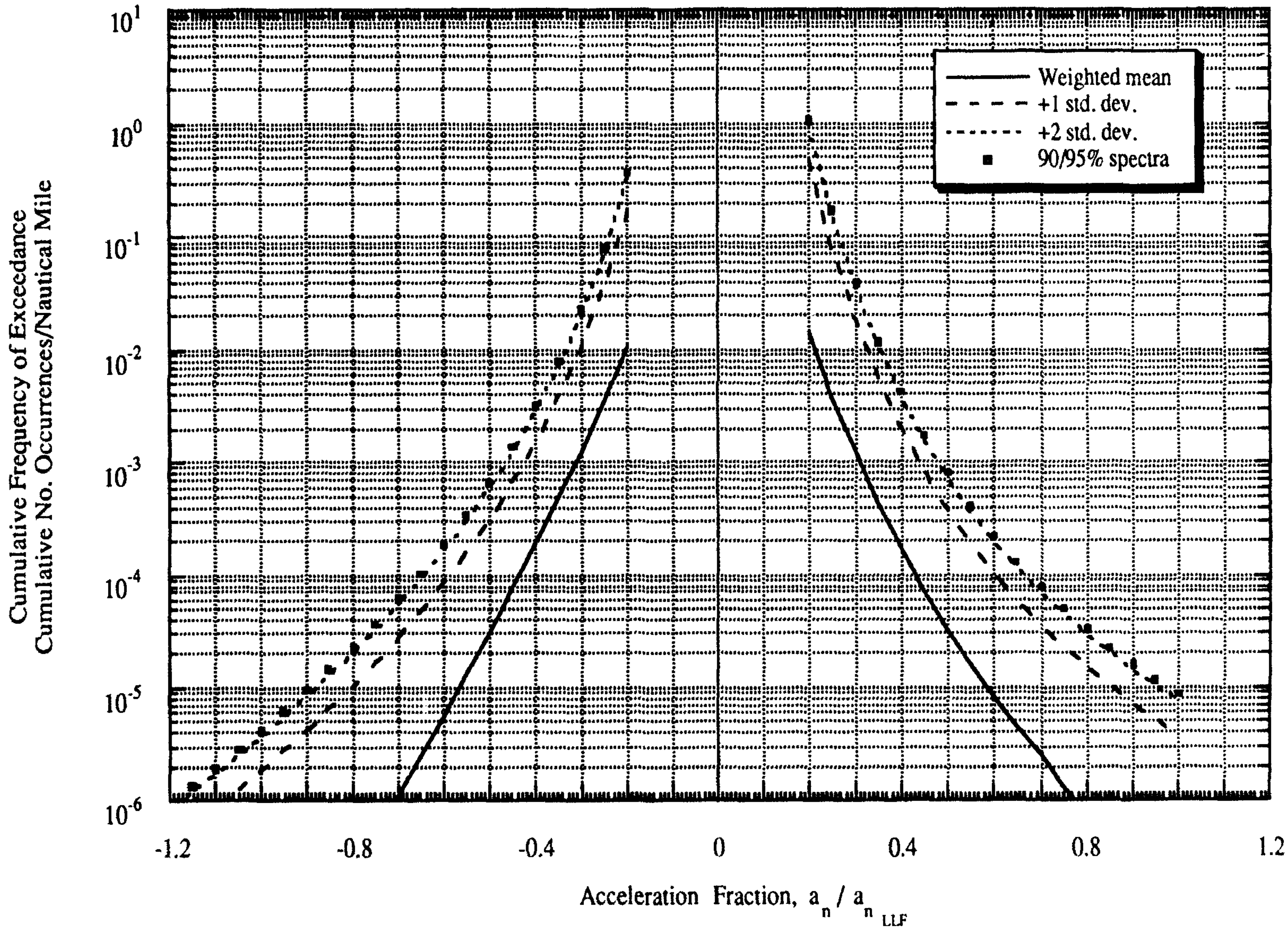
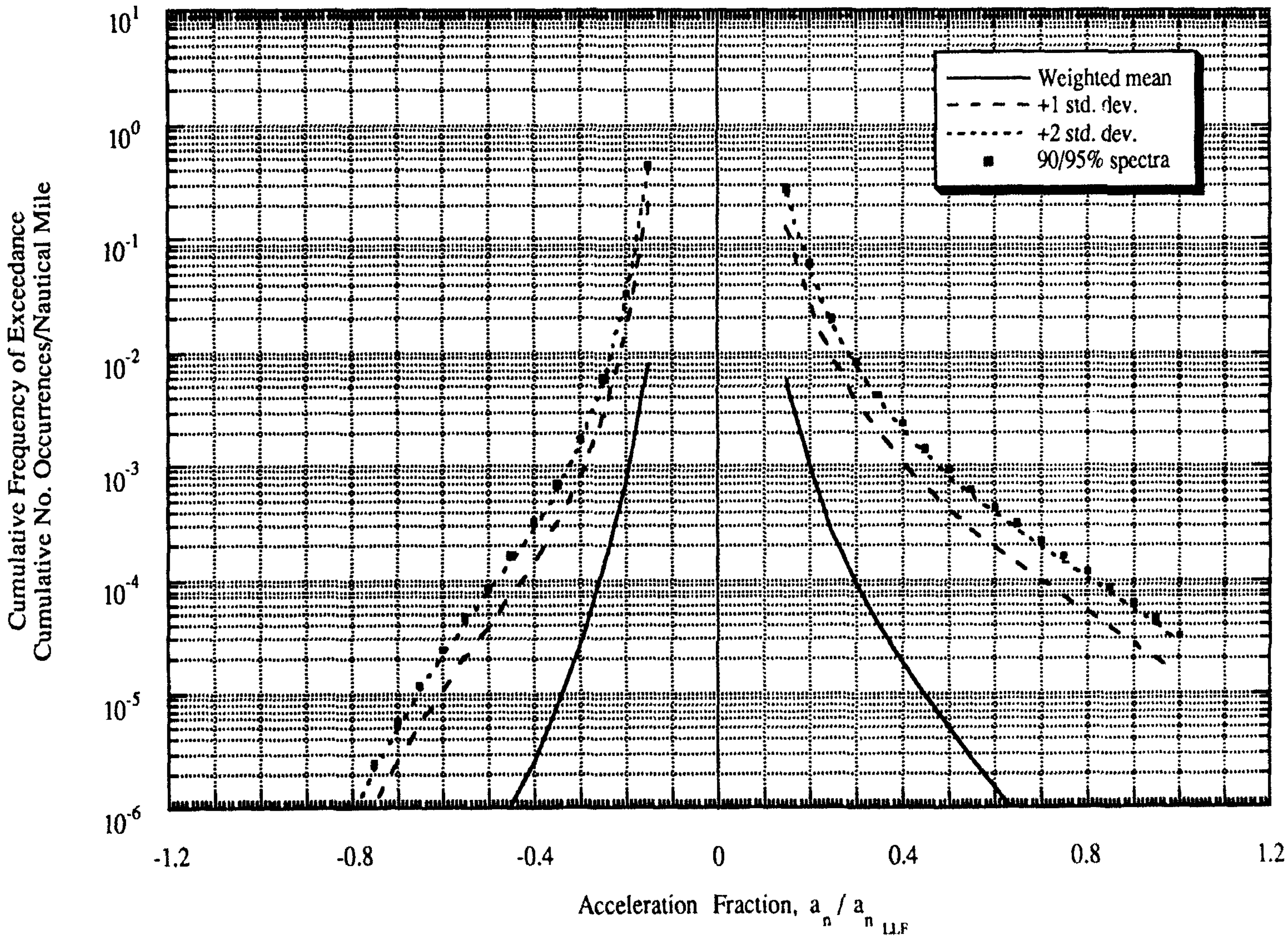


Table 2-19 Maneuver Load Spectra: Single and Twin-Engine Pressurized General Usage

Accel. Fraction	Weighted mean	+1 std. dev.	+2 std. dev.	+3 std. dev.	90/95 % spectra	Accel. Fraction	Weighted mean	+1 std. dev.	+2 std. dev.	+3 std. dev.	90/95 % spectra
-0.150	0.79476E-02	0.20091E+00	0.39386E+00	0.58682E+00	0.43852E+00	0.150	0.57296E-02	0.12572E+00	0.24571E+00	0.36571E+00	0.27348E+00
-0.200	0.73681E-03	0.15141E-01	0.29546E-01	0.43951E-01	0.32880E-01	0.200	0.97738E-03	0.27051E-01	0.53125E-01	0.79198E-01	0.59159E-01
-0.250	0.11667E-03	0.26963E-02	0.52760E-02	0.78557E-02	0.58731E-02	0.250	0.25949E-03	0.88505E-02	0.17441E-01	0.26033E-01	0.19430E-01
-0.300	0.26463E-04	0.78455E-03	0.15426E-02	0.23007E-02	0.17181E-02	0.300	0.92103E-04	0.37394E-02	0.73867E-02	0.11034E-01	0.82309E-02
-0.350	0.75056E-05	0.30604E-03	0.60457E-03	0.90310E-03	0.67366E-03	0.350	0.39387E-04	0.18686E-02	0.36979E-02	0.55271E-02	0.41213E-02
-0.400	0.25593E-05	0.14215E-03	0.28174E-03	0.42133E-03	0.31404E-03	0.400	0.18940E-04	0.10480E-02	0.20770E-02	0.31060E-02	0.23152E-02
-0.450	0.10462E-05	0.72733E-04	0.14442E-03	0.21611E-03	0.16101E-03	0.450	0.96859E-05	0.63763E-03	0.12656E-02	0.18935E-02	0.14109E-02
-0.500	0.49281E-06	0.38830E-04	0.77167E-04	0.11550E-03	0.86040E-04	0.500	0.51005E-05	0.41139E-03	0.81768E-03	0.12240E-02	0.91171E-03
-0.550	0.25257E-06	0.20806E-04	0.41360E-04	0.61914E-04	0.46117E-04	0.550	0.27396E-05	0.27696E-03	0.55117E-03	0.82539E-03	0.61464E-03
-0.600	0.13500E-06	0.10877E-04	0.21619E-04	0.32361E-04	0.24105E-04	0.600	0.14920E-05	0.19225E-03	0.38301E-03	0.57376E-03	0.42715E-03
-0.650	0.73543E-07	0.54308E-05	0.10788E-04	0.16145E-04	0.12028E-04	0.650	0.82041E-06	0.13635E-03	0.27187E-03	0.40740E-03	0.30324E-03
-0.700	0.40397E-07	0.25481E-05	0.50558E-05	0.75635E-05	0.56362E-05	0.700	0.45417E-06	0.98099E-04	0.19574E-03	0.29339E-03	0.21834E-03
-0.750	0.22268E-07	0.11097E-05	0.21970E-05	0.32844E-05	0.24487E-05	0.750	0.25259E-06	0.71195E-04	0.14214E-03	0.21308E-03	0.15856E-03
-0.800	0.12293E-07	0.44448E-06	0.87667E-06	0.13089E-05	0.97669E-06	0.800	0.14092E-06	0.51881E-04	0.10362E-03	0.15536E-03	0.11560E-03
						0.850	0.78797E-07	0.37819E-04	0.75560E-04	0.11330E-03	0.84294E-04
						0.900	0.44123E-07	0.27492E-04	0.54939E-04	0.82386E-04	0.61291E-04
						0.950	0.24732E-07	0.19876E-04	0.39728E-04	0.59580E-04	0.44322E-04
						1.000	0.13873E-07	0.14262E-04	0.28509E-04	0.42757E-04	0.31807E-04

Figure 2-19 Maneuver Load Spectra: Single and Twin-Engine Pressurized General Usage



3. CONCLUSIONS

3.1 Statistical Analysis

A general procedure has been presented for the development of representative gust and maneuver normal acceleration cumulative exceedance spectra for a group of airplanes having varying data collection times. The process consists of curve fitting the individual airplane repeated loads data; computing the mean weighted by flight time, weighted standard deviation, pooled standard deviation, and 90% probability/95% confidence spectra; and analyzing the distribution of the data. Curve fitting the individual airplane data was the most difficult aspect of the process. A general least squares curve fit equation was applied by trial and error to obtain the best fit for each airplane. This process required a considerable amount of iteration for most airplanes. An improvement would be a curve fit method that required no iteration. The methods used to compute the 90% probability/95% confidence spectra also merit further study. It was assumed that all of the data was from a normal population. The cumulative frequency of exceedance histograms in Appendix E demonstrate that this is not the case: the data does not follow a normal distribution.

3.2 General

Since the information and data presented are based on flight measurements, it is prudent to continue to improve their statistical significance. Such improvements can be obtained by using current technology instrumentation, more airplanes added to the sample in a continuing program, and further analysis of all available data.

The original NASA VGH program focused on normal (z-direction) accelerations. A similar program is needed for fatigue of vertical aerodynamic surfaces such as fins, rudders, winglets, and their supporting structures. A lateral gust (y-direction), and corresponding maneuver loads program would be a valuable supplement to the work presently completed.

3.3 Comparison of Normal Acceleration Exceedance Spectra

The following observations are made for the 90% probability/ 95% confidence spectra, by visual comparison of overlays of the following figures:

a. Gust Spectra

(1) Single-Engine General Usage, Fig. 2-6 (34 airplanes): There is negligible difference when comparing this spectrum with the Basic Flight Instruction, Fig.2-2 (10 airplanes), and Business/Personal, Fig. 2-4 (24 airplanes), spectra. Fig. 2-6 contains all the data in Figs. 2-2 and 2-4.

(2) The Single-Engine General Usage, Fig. 2-6 (34 airplanes), and the Twin-Engine General Usage, Fig. 2-12 (8 airplanes), curves are very close, except the Single-Engine curves are slightly less severe at acceleration fractions greater than 0.4 and less than -0.2.

(3) Special Usage: The spectrum, Fig. 2-16 (7 airplanes) combining both Single-Engine, Fig. 2-8 (4 airplanes), and Twin-Engine, Fig. 2-14 (3 airplanes) is very close to the individual spectra. It is recommended to use the combined spectrum, Fig. 2-16, which includes all of the available small airplane Special Usage data and, therefore should be more statistically significant.

(4) The combined Special Usage spectrum (Fig. 2-16) is more severe than either the Single-Engine (Fig. 2-6) or the Twin-Engine General Usage spectrum (Fig. 2-12). This is as expected since Special Usage operations are generally flown at low altitudes where turbulence is greater.

(5) The Pressurized General Usage spectrum (Single and Twin-Engine combined), Fig. 2-18, is very close to the Single Engine (Fig. 2-6) and Twin-Engine General Usage spectra (Fig. 2-12). However, the mean curve is lower, reflecting the higher altitude operations for pressurized airplanes. The pressurized operations are only for 3 airplanes. It is expected that if more data were available, the 90% probability/95% confidence curves would decrease in severity with a larger sample size.

(6) The Aerial Application spectrum, Fig. 2-10 (25 single-engine airplanes), is nearly identical to the Single-Engine General Usage spectrum (Fig. 2-6). Although these airplanes are operated at very low altitude, they are usually flown early in the day when wind (and turbulence) is very low. The Aerial Application spectrum also compares very closely with the Twin-Engine General Usage spectrum (Fig. 2-12).

b. <u>Maneuver Spectra</u>

(1) The Single-Engine Basic Flight Instruction, Fig. 2-3 (10 airplanes), spectrum is more severe than the Single-Engine Business/Personal, Fig. 2-5 (24 airplanes) spectrum. The positive mean spectrum is very much less severe for the latter group and this indicates the wide variability in usage of Business/Personal type airplanes.

(2) The Single-Engine General Usage spectrum, Fig. 2-7, (34 airplanes) combines the data in the Basic Flight Instruction and Business/Personal sub-groups (discussed in b(1) above) and lies between those two spectra. It appears to be a close representation of the two sub-groups.

(3) The Single-Engine General Usage, Fig. 2-7 (34 airplanes), and the Twin-Engine General Usage, Fig. 2-13 (8 airplanes), curves are very close (although the means differ considerably).

(4) Special Usage: The spectrum, Fig. 2-17 (7 airplanes) combining both Single-Engine, Fig. 2-9 (4 airplanes), and Twin-Engine, Fig. 2-15 (3 airplanes) is very close to the individual spectra. It is recommended to use the combined spectrum, Fig. 2-17, which includes all of the available small airplane Special Usage data and, therefore should be more statistically significant.

The Special Usage (combined) spectrum, Fig. 2-17, is very close to the Single-Engine General Usage spectrum, Fig. 2-7, except it is more severe for the acceleration fraction range 0.1 to 0.6.

(5) The Pressurized General Usage spectrum (Single and Twin-Engine combined), Fig. 2-19, is very close to the Single Engine (Fig. 2-7) and Twin-Engine General Usage spectra (Fig. 2-13). However, the mean spectrum is lower, reflecting the expectation of less maneuvering with higher altitude operations for pressurized airplanes. The pressurized operations are only for 3 airplanes. It is expected that if more data were available, the 90% probability/95% confidence spectrum would decrease in severity with a larger sample size.

(6) The Aerial Application spectrum, Fig. 2-11 (25 single-engine airplanes) is very much more severe than all of the other maneuver spectra. To illustrate, it is about 200 times more severe than the Single-Engine General Usage spectrum, Fig. 2-7, at an acceleration fraction of 0.4.

3.4 Analytical Studies and Future Work

This is discussed in Section 1.6 (page 1-4). The effect (or confirmation of negligible effect) on airplane fatigue life of the load spectra comparisons made above should also be studied analytically.

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APPENDIX A:

AIRPLANE DESCRIPTIVE DATA

This appendix contains data describing the airplanes in the NASA VGH General Aviation Program (Refs. 2 and 4). Airplane manufacturers' model designations have been purposely omitted. Each specific airplane type was assigned a number, and different models of that type were assigned a letter designation after the number. Types of airplane operations selected to represent general aviation usage are as follows: twin-engine executive, single-engine executive, personal, instructional, commercial survey, aerial application, aerobatic, commuter, and floatplane. When there were two or more airplanes of the same type or model, a numerical superscript was used to distinguish one from the other, thereby noting the use of the same airplane type and model in different operations and different geographical locations.

TABLE A-1: GROUP 1A -- SINGLE-ENGINE, INSTRUCTIONAL

CHARACTERISTIC	AIRPLANE						
	12B	14	14A	15	16	17	18
Maximum weight, lb	2150	2450	2200	2250	1650	1500	1500
Wing span, ft	30.0	32.8	32.8	35.0	30.0	33.4	35.2
Wing area, ft^2	160.0	146.0	146.0	180.0	147.0	160.0	170.0
Type propulsion Power per engine, hp	Piston 140	Piston 180	Piston 150	Piston 150	Piston 108	Piston 100	Piston 95
V_C at sea level, knots	122	128	128	117	96	104	87
V_{NE} at sea level, knots	148	162	162	[illegible]	129	137	117
V_D at sea level, knots	165	180	180	164	143	152	130
n_m at V_C	3.80	4.40	4.40	3.60	4.40	4.40	4.52
$-n_m$ at V_C	1.52	1.90	1.90	1.52	1.76	1.76	1.20
n_g at V_C	3.30	[a]3.58	[a]3.80	[a]3.46	3.00	3.46	3.38
$-n_g$ at V_C	1.30	[a]1.58	[a]1.80	[a]1.46	1.00	1.46	1.38

[a]Calculated.

TABLE A-2: GROUP 1B -- SINGLE-ENGINE, EXECUTIVE

CHARACTERISTIC	AIRPLANE								
	6*	7	7A	7B	7C	8	8A	9	9A
Maximum weight, lb	4000	3400	3300	3125	2650	3200	2900	2650	2500
Wing span, ft	36.8	33.5	33.5	33.5	32.8	36.0	36.0	36.0	36.0
Wing area, ft^2	175.0	181.0	181.0	181.0	177.6	178.0	178.0	174.0	174.0
Type propulsion Power per engine, hp	Piston 310	Piston 180	Piston 285	Piston 260	Piston 185	Piston 260	Piston 250	Piston 230	Piston 225
V_C at sea level, knots	165	285	165	161	139	156	156	139	139
V_{NE} at sea level, knots	198	195	195	195	175	197	197	162	160
V_D at sea level, knots	220	217	217	217	217	219	219	180	177
n_m at V_C	3.80	4.40	4.40	4.40	4.40	3.80	3.80	3.80	3.80
$-n_m$ at V_C	1.52	1.76	1.76	1.76	1.76	1.52	1.52	1.52	1.52
n_g at V_C	3.30	3.37	3.35	3.43	3.40	3.48	3.65	3.33	3.50
$-n_g$ at V_C	1.30	1.37	1.35	1.43	1.40	1.48	1.65	1.33	1.50

*This airplane is also included in Group 6.

TABLE A-3: GROUP 1B -- SINGLE-ENGINE, PERSONAL

CHARACTERISTIC	AIRPLANE							
	10	10A	11	12	12A	13	28[b]	41[c]
Maximum weight, lb	2740	2575	2475	2400	2200	2250	1500	5090
Wing span, ft	35.0	35.0	35.0	30.0	30.0	36.0	35.2	48.0
Wing area, ft^2	167.0	167.0	180.0	160.0	160.0	174.0	178.5	250.0
Type propulsion Power per engine, hp	Piston 200	Piston 180	Piston 180	Piston 180	Piston 160	Piston 174.0	Piston 95	Piston 450
V_C at sea level, knots	152	130	122	122	122	122	95	126
V_{NE} at sea level, knots	175	164	153	148	148	139	129	135
V_D at sea level, knots	194	182	170	165	165	165	143	152
n_m at V_C	3.80	3.80	3.80	3.80	3.80	3.80	4.40	[a]3.69
$-n_m$ at V_C	1.52	1.52	1.52	1.52	1.52	1.52	1.76	[a]1.48
n_g at V_C	3.37	3.42	[a]3.41	3.30	3.30	3.39	3.59	[a]2.79
$-n_g$ at V_C	1.37	1.42	[a]1.41	1.30	1.30	1.39	1.59	[a]0.79

[a]Calculated. [b]Used in commercial fish spotting operations. [c]Floatplane used in "bush" operations.

TABLE A-4: GROUP 2 -- SINGLE-ENGINE, SPECIAL USAGE

CHARACTERISTIC	6A	9B	17[1]	27
Maximum weight, lb	3800	2800	1500	2950
Wing span, ft	36.8	36.2	33.4	32.8
Wing area, ft^2	175.0	174.0	160.0	177.6
Type propulsion Power per engine, hp	Piston 285	Piston 230	Piston 100	Piston 225
V_C at sea level, knots	165	139	104	152
V_{NE} at sea level, knots	195	167	137	219
V_D at sea level, knots	217	186	152	243
n_m at V_C	3.80	3.80	4.40	6.00
$-n_m$ at V_C	1.52	1.52	1.76	3.00
n_g at V_C	3.41	3.33	3.46	3.26
$-n_g$ at V_C	1.41	1.33	1.46	1.26

TABLE A-5: GROUP 3 -- AERIAL APPLICATION

CHARACTERISTIC	AIRPLANE											
	29	30	30A	31	32	33	33A	34	35	36	36A	37
Maximum weight, lb	8200	6900	6000	6900	6075	6075	6075	4400	4200	4000	3800	2900
Wing span, ft	44.4	44.4	42.6	45.1	Upper 35.7*	Upper 35.7*	Upper 35.7*	38.8	41.1	40.7	40.7	36.2
Wing area, ft^2	326.6	326.6	312.4	270.6	328.0	326.0	326.0	255.0	208.7	202.0	202.0	183.0
Type propulsion Power per engine, hp	Turboprop 750	Piston 600	Piston 650	Piston 600	Turboprop 750	Piston 650	Piston 600	Piston 285	Piston 300	Piston 300	Piston 230	Piston 235
V_C at sea level, knots	117	117	109	113	128	128	128	130	125	125	125	108
V_{NE} at sea level	148	148	138	153	128	128	128	158	158	1158	158	135
V_D at sea level, knots	164	164	153	170	142	142	142	175	175	175	175	151
n_m at V_C	3.80	3.80	3.80	3.80	4.20	4.20	4.20	3.80	3.80	3.80	3.80	3.80
$-n_m$ at V_C	1.52	1.90	1.90	1.90	1.00	1.00	1.00	1.52	1.52	1.52	1.52	1.52
n_g at V_C	^{b}3.07	^{b}2.78	^{b}2.78	2.51	^{b}2.60	^{b}2.62	^{b}2.62	3.25	3.31	3.31	3.31	2.83
$-n_g$ at V_C	^{b}1.07	^{b}0.78	^{b}0.78	0.51	^{b}0.60	^{b}0.62	^{b}0.62	1.25	1.31	1.31	1.31	0.83

Notes:
1. All airplanes, except 30A and 37, are Restricted Category.
2. All airplanes are single engine.
3. * indicates Biplane.

TABLE A-6: GROUP 4 -- TWIN-ENGINE, GENERAL USAGE

CHARACTERISTIC	4	4A	5	39	40
Maximum weight, lb	4830	5300	4800	11,600	10,400
Wing span, ft	36.0	37.0	37.0	65.0	45.9
Wing area, ft^2	175.0	179.0	207.0	420.0	279.7
Type propulsion Power per engine, hp	Piston 260	Piston 260	Piston 250	Turboprop 550	Turboprop 550
V_C at sea level, knots	182	182	172	160	226
V_{NE} at sea level, knots	215	223	216	178	254
V_D at sea level, knots	239	248	240	225	282
n_m at V_C	3.80	3.80	3.80	3.21	3.29
$-n_m$ at V_C	1.52	1.52	1.52	1.50	1.32
n_g at V_C	2.97	2.84	3.10	3.35	2.95
$-n_g$ at V_C	0.97	0.84	1.10	1.35	0.95

TABLE A-7: GROUP 5 -- TWIN-ENGINE, SPECIAL USAGE

CHARACTERISTIC	AIRPLANE		
	4[1]	25	26
Maximum weight, lb	4830	5400	4300
Wing span, ft	36.0	37.8	38.0
Wing area, ft^2	175.0	199.2	201
Type propulsion Power per engine, hp	Piston 260	Piston 285	Piston 210
V_C at sea level, knots	182	195	165
V_{NE} at sea level, knots	215	223	202
V_D at sea level, knots	239	247	215
n_m at V_C	3.80	4.20	3.80
$-n_m$ at V_C	1.52	3.00	1.52
ng at V_C	2.97	3.20	3.16
$-n_g$ at V_C	0.97	1.20	1.16

TABLE A-8: GROUP 6 -- PRESSURIZED, GENERAL USAGE

CHARACTERISTIC	AIRPLANE	
	3	6*
Maximum weight, lb	9000	4000
Wing span, ft	45.9	36.8
Wing area, ft^2	279.9	175.0
Type propulsion Power per engine, hp	Turboprop 500 Twin-Engine	Piston 310 Single-Engine
V_C at sea level, knots	208	165
V_{NE} at sea level, knots	234	198
V_D at sea level, knots	260	220
n_m at V_C	3.40	3.80
$-n_m$ at V_C	1.68	1.52
n_g at V_C	3.10	3.30
$-n_g$ at V_C	1.10	1.30

*This airplane is also included in Group 1B.

TABLE A-9: TWIN-ENGINE, EXECUTIVE JET

Airplane Data	Twin-engine executive operations for airplane type--		
	1	2	2A
Maximum weight, lb	26,455	13,000	12,500
Wing span, ft	53.5	35.8	35.8
Wing area, ft^2	441	231.8	231.8
Type propulsion Thrust per engine, lb	Turbojet 4200	Turbojet 2850	Turbojet 2850
V_C at sea level, knots	388	350	350
V_{NE} at sea level, knots	437	300	358
V_D at sea level, knots	485	400	400
n_m at V_C	2.50	4.40	4.40
$-n_m$ at V_C	1.00	1.76	1.76
ng at V_C	4.40	3.44	3.44
$-n_g$ at V_C	2.40	1.44	1.44

TABLE A-10: LARGE AIRPLANES, SPECIAL USAGE

Airplane Data	Commercial survey operations for airplane type--					
	19	20	21	22	23	24
Maximum weight, lb	126,000	106,000	80,000	64,000	31,000	26,300
Wing span, ft	117.5	117.5	98.0	109.3	95.0	69.7
Wing area, ft^2	1463	1457	1000	1447	987.0	485.0
Type propulsion	Piston	Piston	Piston, turbojet	Piston	Piston	Piston
Power per engine, hp	3250	2400	3500	3250	1475	1525
Thrust per engine, lb			3400			
V_C at sea level, knots	269	260	175	†NA	163	130
V_{NE} at sea level, knots	313	313	225	NA	188	336
V_D at sea level, knots	346	346	360	†NA	209	373
n_m at V_C	2.50	2.50	3.00	3.00	2.50	3.00
$-n_m$ at V_C	1.00	1.00	1.00	1.00	1.00	1.00
n_g at V_C	*2.42	*2.79	*2.31	*2.81	*3.74	*3.16
$-n_g$ at V_C	*0.42	*0.79	*0.31	*0.81	*1.74	*1.16

*Calculated. †Not available.

TABLE A-11: AEROBATIC AIRPLANE

Airplane Data	Aerobatic operations for airplane type--
	38
Maximum weight, lb	1650
Wing span, ft	33.4
Wing area, ft^2	165.0
Type propulsion *Power per engine, hp*	Piston 150
V_C at sea level, knots	104
V_{NE} at sea level, knots	140
V_D at sea level, knots	156
n_m at V_C	5.07
$-n_m$ at V_C	2.29
n_g at V_C	4.38
$-n_g$ at V_C	2.38

APPENDIX B:

AIRPLANE IDENTIFICATION--
NASA AND UNIVERSITY OF KANSAS

OPERATING ALTITUDES

OPERATING LOCATIONS

PRIMARY USE AND OPERATOR CATEGORY

AIRPLANE IDENTIFICATION EQUIVALENTS

(Cross Index)

NASA I.D.	KU I.D.
2	251-777
3	255-203
4	310-110
4[1]	310-117
6	210-140
6A	210-606
14	223-110
19	437-318
30	945-193
30A	945-634
31	190-410
32[1]	782-722
33	781-395
33A[2]	781-792
34[1]	281-600
34[3]	625-993
35	170-200
35[1]	170-217
35[2]	170-864
38	753-049
41	252-772

AIRPLANE IDENTIFICATION NUMBERS

1A. Single-Engine, Basic Flight Instructions (10 Airplanes)

NASA	KU	Home Base State	Altitude*, Feet	Comments
12B		NB	2,500	
12B[1]		IN	2,385	
12B[2]		IL	2,170	
14	223-110	IL	1,705	
14A		OH	2,380	
15		TX	2,720	
16		SC	1,505	
17		CO	6,905	
18		CA	2,000	
18[1]		CA	2,030	

1B. Single-Engine, Business/Personal (24 Airplanes)

NASA	KU	Home Base State	Altitude*, Feet	Comments
6	210-140	NY	13,085	Executive class
7		MT	7,520	Executive class
7A		VA	4,765	Executive class
7B		NM	8,045	Executive class
7C		DC	4,555	Executive class
7C[1]		NY	3,720	Executive class
8		ID	7,345	Executive class

*From Table II, Ref. 4. Average Pressure Altitude.

NASA	KU	Home State Base	Altitude*, Feet	Comments
8A		WY	8,350	Executive class
8A[1]		TX	5,000	Executive class
9		IN	4,540	Executive class
9A		ID	7,395	Executive class
10	437-318	TX	6,120	Personal class
10[1]		VA	3,515	Personal class
10A		CA	5,735	Personal class
11		CA	4,115	Personal class
12		FL	2,215	Personal class
12[1]		FL	1,175	Personal class
12[2]		FL	2,415	Personal class
12[3]		SC	2,790	Personal class
12A		FL	1,440	Personal class
13		SC	3,005	Personal class
13[1]		UT	6,755	Personal class
28		VA	1,705	Fish spotting
41	252-772	WA	2,505	Floatplane
2. Single-Engine, Special Usage (4 Airplanes)				
6A	210-606	WY	6,080	Pipeline patrol
9B		OR	6,895	Forest fire patrol and transport

*From Table II, Ref. 4. Average Pressure Altitude.

NASA	KU	Home Base State	Altitude*, Feet	Comments
17[1]		OK	1,150	Pipeline patrol
27		OR	5,060	Forest fire lead plane

3. Aerial Application (25 Airplanes; all are single-engine.)

NASA	KU	Home Base State	Altitude*, Feet	Comments
29		AL	165	
29[1]		TX	195	
30	945-193	OR	840	
30[1]		NE	2,370	
30[2]		OR	665	
30A	945-634	AZ	1,150	
31	190-410	AZ	2,995	
32		TX	85	
32[2]		TX	535	
33	781-395	VA	490	
33[1]		TX	10	
33A		CA	150	
33A[1]		TX	85	
33A[2]	781-792	CA	145	
34		AZ	2,380	
34[1]	281-600	TX	1,295	
34[2]		FL	660	

*From Table II, Ref. 4. Average Pressure Altitude.

NASA	KU	Home Base State	Altitude*, Feet	Comments
34[3]	625-993	FL	195	
35	170-200	MT	4,980	
35[1]	170-217	TX	1,350	
35[2]	170-864	TX	3,770	
36		TX	95	
36A		AZ	930	
37		FL	170	
37[1]		TX	2,690	

4. Twin-Engine, General Usage, (8 Airplanes)

NASA	KU	Home Base State	Altitude*, Feet	Comments
4		WI	4,445	Charter, Check flights
5		VA	4,695	Charter, Check flights
5[1]		CA	7,410	*Business/Pleasure*
4A		FL	2,010	Flight instruction
	255-203 310-110			Flight instruction
39		CA	2,325	Commuter
40		PA	4,280	Commuter

5. Twin-Engine, Special Usage (3 Airplanes)

NASA	KU	Home Base State	Altitude*, Feet	Comments
4[1]	310-117	ID	6,910	Forest fire lead plane
25		NM	7,478	Forest fire lead plane
26		NE	2,870	Pipeline patrol

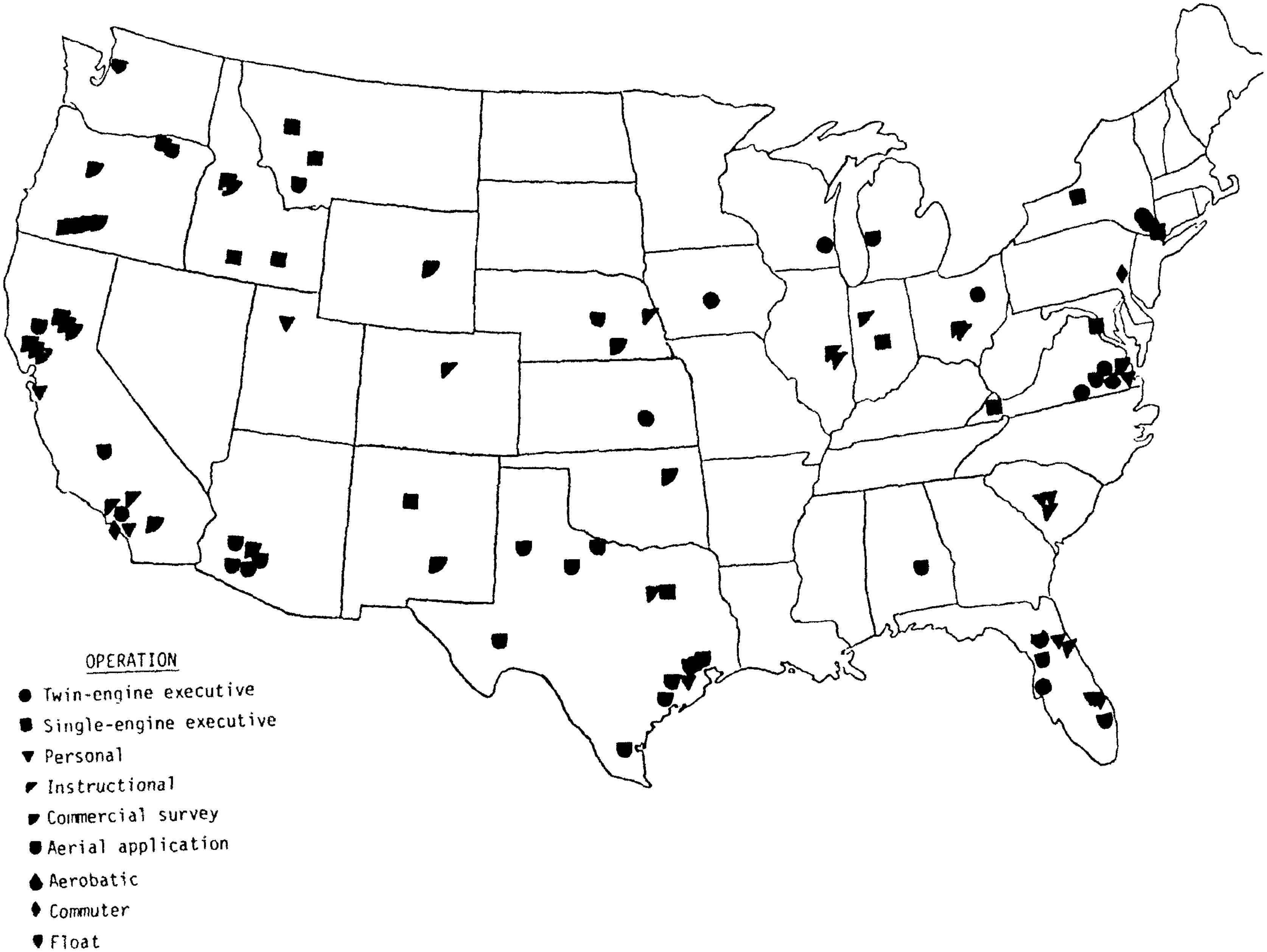
*From Table II, Ref. 4. Average Pressure Altitude.

NASA	KU	Home Base State	Altitude*, Feet	Comments
6. Pressurized, General-Usage (3 Airplanes)				
3		KS	11,145	Twin, Turboprop
3[1]		VA	9,915	Twin, Turboprop
6	210-140	NY	13,085 (11,400)	Single, Recip. (Estimated, including data reduced by KU.)
7. Twin-Engine, Executive Jet (3 Airplanes)				
1		FL	24,535	
2	251-777	IA	29,905	
2A		OH	23,215	
8. Large Airplanes, Special Usage (6 Airplanes)				
19	437-318	OR	4,950	Forest fire fighting
19[1]		AZ	5,165	Forest fire fighting
20		OR	5,015	Forest fire fighting
20[1]		OR	5,368	Forest fire fighting
21		OR	5,260	Forest fire fighting
22		CA	2,960	Forest fire fighting
23		ID	8,162	Forest fire fighting
24		CA	2,905	Forest fire fighting
24[1]		CA	2,920	Forest fire fighting
24[2]		CA	2,835	Forest fire fighting
24[3]		CA	3,355	Forest fire fighting
24[4]		CA	2,855	Forest fire fighting
24[5]		CA	1,955	Forest fire fighting

*From Table II, Ref. 4. Average Pressure Altitude.

NASA	KU	Home Base State	Altitude*, Feet	Comments
9. Acrobatic Airplane				
38	753-049	VA	1,660	Aerobatic flying

*From Table II, Ref. 4. Average Pressure Altitude.



Map indicating instrumented airplane's home bases (Ref. 2).

PRIMARY USE AND OPERATOR CATEGORY OF INSTRUMENTED AIRPLANES

(References 2 and 4)

Twin-engine executive:

Airplane type	Operated by	Primary use
1,2,2A,3[1]	Companies	Business flights
1[1],1[2],1[3],3	Airplane manufacturers	Flight demonstration; executive transport; cargo carrier
4 and 5	Fixed-base operator	Charter flights; transition to heavier aircraft; instrument flights; and check flights
5[1]	Individual	Ambulance; business; pleasure

Single-engine executive:

Airplane type	Operated by	Primary use
6,7C,7C[1],9	Individuals	Business and pleasure flights
7,7A,7B,8A	Companies	Business and cargo flights
8,8A[1],9A	Fixed-base operator	Charter flights for personnel and cargo; instrument check flights; transition to heavier aircraft

Personal:

Airplane type	Operated by	Primary use
10^1,10A,12,12^1, 12^2,12^3,12A,13,13^1	Flying club	Pleasure, business, and instructional flights
10	Individual	Pleasure and business flights
11	Fixed-base operator	Pleasure, business, and instructional flights

Instructional:

Airplane type	Operated by	Primary use
12B,15,16,17, 18,18^1	Fixed-base operators	Basic flight instruction
$12B^1$,$12B^2$,14,14A	University	Basic flight instruction
4A	University	Twin-engine basic and advanced flight instruction; instrument instruction

Commercial survey:

Airplane type	Operated by	Primary use
4^1,25,27	Contracted for by U.S. Forest Service	Lead planes for retardant tankers; check for excessive turbulence; mark drop site
9B	Contracted for by U.S. Forest Service	Scout for forest fires; transport cargo and personnel
23	U.S. Forest Service	Smoke jumper for fire fighters; personnel and cargo carrier
19,19^1,20,20^1,21, 22,24,24^1,24^2,24^3 24^4,24^5	Contracted for by U.S. Forest Service	Drop retardant on forest fires
6A,17^1,26	Gas and oil pipeline companies	Pipeline patrol over level and mountainous terrain
28	Individual	Fish spotting for commercial trawlers

Aerial application:

Airplane type	Operated by	Primary use
29, 29^{1}, 30, 30^{1}, 30^{2}, 30A, 31, 32, 32^{1}, 32^{2}, 33, 33^{1}, 33A, $33A^{1}$, $33A^{2}$, 34, 34^{1}, 34^{2}, 35, 35^{1}, 35^{2}, 36, 36A, 37, 37^{1}	Individuals and companies	Disperse chemicals for control of herbs, pests, and insects on farmlands
34^{3}	State	Disperse chemicals for control of herbs and insects on lakes and streams

Aerobatic:

Airplane type	Operated by	Primary use
38	Fixed-base operator	Aerobatic instruction and practice

Commuter:

Airplane type	Operated by	Primary use
39,40	Commuter airlines	Passenger flights; test and check flights

Float:

Airplane type	Operated by	Primary use
41	Fixed-base operator	Personnel and cargo charter; bush-type operations

APPENDIX C:

NORMAL ACCELERATION EXCEEDANCE CURVES AND DATA TABLES FOR INDIVIDUAL AIRPLANES

Airplane	Tabulated Data	Load Spectra Plots
33^1	C-105	C-106
33A	C-107	C-108
$33A^1$	C-109	C-110
$33A^2$	C-111	C-112
34	C-113	C-114
34^1	C-115	C-116
34^2	C-117	C-118
34^3	C-119	C-120
35	C-121	C-122
35^1	C-123	C-124
35^2	C-125	C-126
36	C-127	C-128
36A	C-129	C-130
37	C-131	C-132
37^1	C-133	C-134

4. Twin-Engine, General Usage

4	C-135	C-136
5	C-137	C-138
5^1	C-139	C-140
4A	C-141	C-142
39	C-143	C-144
40	C-145	C-146
255-203	C-147	C-148
310-110	C-149	C-150

5. Twin-Engine, Special Usage

4^1	C-151	C-152
25	C-153	C-154
26	C-155	C-156

Airplane	Tabulated Data	Load Spectra Plots
6. Pressurized, General Usage		
3	C-157	C-158
3^1	C-159	C-160
6	C-27	C-28
7. Twin-Engine, Executive Jet		
*1	C-161	C-162
$*1^1$	C-163	C-164
$*1^2$	C-165	C-166
$*1^3$	C-167	C-168
*2	C-169	C-170
*2A	C-171	C-172
8. Large Airplanes, Special Usage		
*19	C-173	C-174
$*19^1$	C-175	C-176
*20	C-177	C-178
$*20^1$	C-179	C-180
*21	C-181	C-182
*22	C-183	C-184
*23	C-185	C-186
*24	C-187	C-188
$*24^1$	C-189	C-190
$*24^2$	C-191	C-192
$*24^3$	C-193	C-194
$*24^4$	C-195	C-196
$*24^5$	C-197	C-198

* - Non-Statistical Airplane

Airplane	Tabulated Data	Load Spectra Plots
9. Aerobatic Airplane		
*38	C-199	C-200

* - Non-Statistical Airplane

Table C-1 Tabulated Data for Airplane 12B

Total Nautical Miles = 25703 Total Hours = 311

GUST				MANEUVER			
negative		positive		negative		positive	
Acceleration Fraction	Cumulative Frequency of Exceedance	Acceleration Fraction	Cumulative Frequency of Exceedance	Acceleration Fraction	Cumulative Frequency of Exceedance	Acceleration Fraction	Cumulative Frequency of Exceedance
-0.200	0.0355268	0.200	0.0421813	-0.200	0.0063628	0.150	0.0782664
-0.250	0.0095696	0.250	0.0115093	-0.250	0.0022851	0.200	0.0325504
-0.300	0.0028579	0.300	0.0031641	-0.300	0.0009071	0.250	0.0163077
-0.350	0.0008954	0.350	0.0008409	-0.350	0.0003801	0.300	0.0091711
-0.400	0.0002348	0.400	0.0002107	-0.400	0.0001636	0.350	0.0055755
		0.450	0.4902E-04			0.400	0.0035827
						0.450	0.0023984
						0.500	0.0016561
						0.550	0.0011713
						0.600	0.0008441
						0.650	0.0006174
						0.700	0.0004568
						0.750	0.0003412
						0.800	0.0002567
						0.850	0.0001937
						0.900	0.0001462
						0.950	0.0001103

NOTE: for curve fits $x = |x|$

Curve fit for original data $(-0.400 < x < -0.196)$
$\log(y) = -4.240 - 6.516x^2 - 4.366\log(x)$
Curve fit for extrapolation $(-1.200 < x < -0.400)$
$\log(y) = 0.435 - 9.952x$

Curve fit for original data $(0.196 < x < 0.450)$
$\log(y) = -3.226 - 10.960x^2 - 3.276\log(x)$
Curve fit for extrapolation $(0.450 < x < 1.362)$
$\log(y) = 1.552 - 13.026x$

Curve fit for original data $(-0.400 < x < -0.179)$
$\log(y) = -4.564 - 4.156x^2 - 3.624\log(x)$
Curve fit for extrapolation $(-0.800 < x < -0.400)$
$\log(y) = -0.882 - 7.260x$

Curve fit for original data $(0.161 < x < 0.800)$
$\log(y) = -3.548 - 0.518x^2 - 2.977\log(x)$
Curve fit for extrapolation $(0.800 < x < 1.600)$
$\log(y) = -1.635 - 2.445x$

Figure C-1 Load Spectra for Airplane 12B, Single-Engine, Basic Flight Instruction

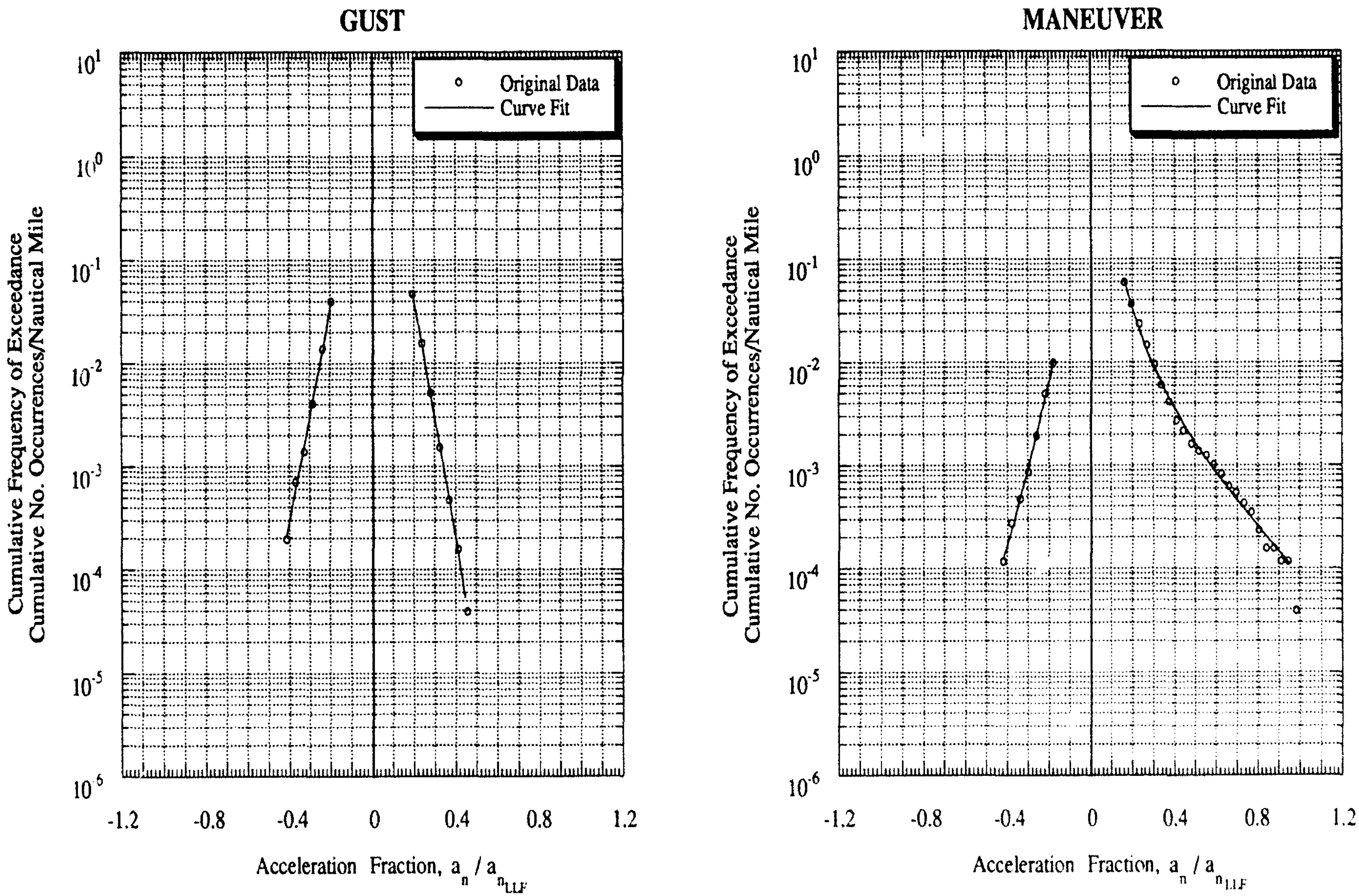


Table C-2 Tabulated Data for Airplane 12B[1]

Total Nautical Miles = 40524 Total Hours = 448

GUST negative		GUST positive		MANEUVER negative		MANEUVER positive	
Acceleration Fraction	Cumulative Frequency of Exceedance	Acceleration Fraction	Cumulative Frequency of Exceedance	Acceleration Fraction	Cumulative Frequency of Exceedance	Acceleration Fraction	Cumulative Frequency of Exceedance
-0.200	0.0153941	0.200	0.0152346	-0.200	0.0166386	0.150	0.1078405
-0.250	0.0044298	0.250	0.0035387	-0.250	0.0087528	0.200	0.0519350
-0.300	0.0011183	0.300	0.0010862	-0.300	0.0046060	0.250	0.0278226
-0.350	0.0002427	0.350	0.0004049	-0.350	0.0023765	0.300	0.0157567
-0.400	0.4471E-04	0.400	0.0001743	-0.400	0.0011880	0.350	0.0091802
		0.450	0.8391E-04	-0.450	0.0005710	0.400	0.0054140
				-0.500	0.0002625	0.450	0.0031983
				-0.550	0.0001149	0.500	0.0018791
				-0.600	0.4783E-04	0.550	0.0010924
						0.600	0.0006260
						0.650	0.0003527
						0.700	0.0001948
						0.750	0.0001054
						0.800	0.5574E-04
						0.850	0.2914E-04
						0.900	0.1523E-04
						0.950	0.7960E-05
						1.000	0.4161E-05
						1.050	0.2175E-05

NOTE: for curve fits x = |x|

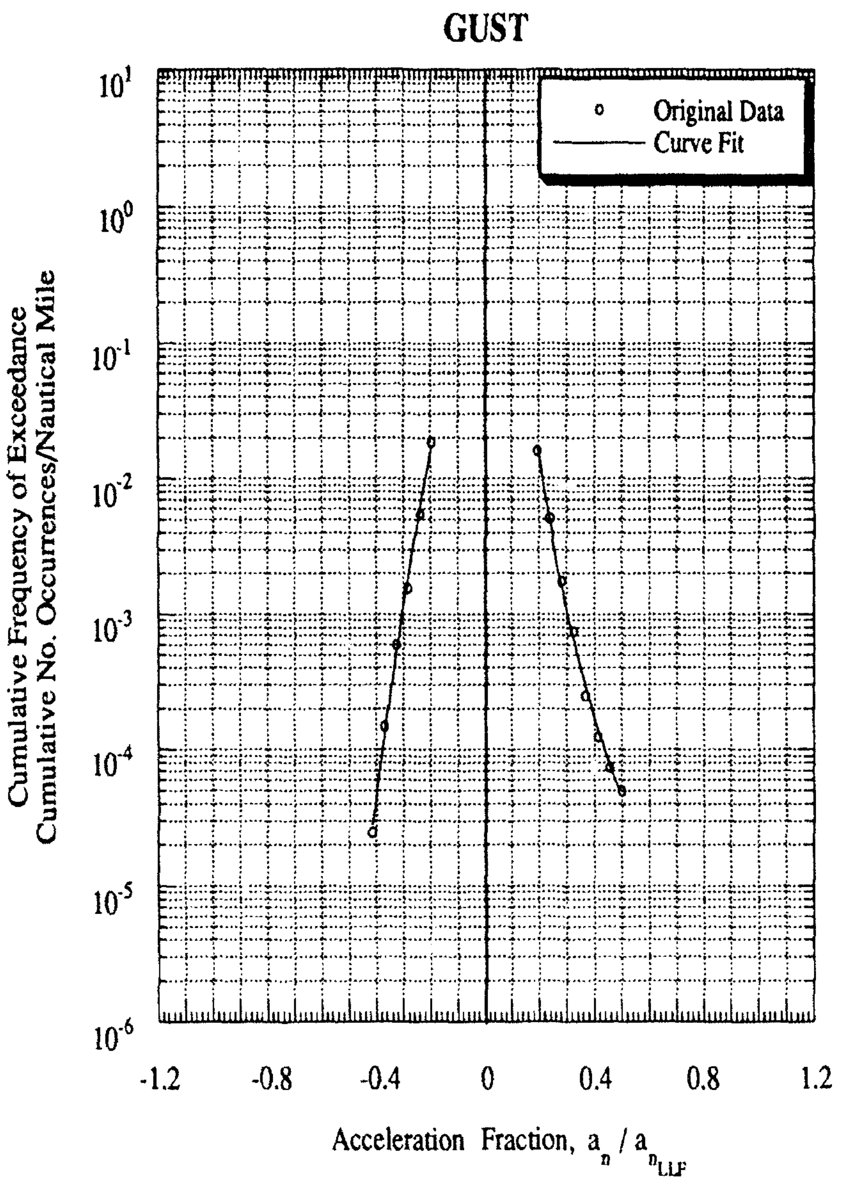
Curve fit for original data (-0.400 < x < -0.196)
$\log(y) = -2.257 - 17.093x^2 - 1.614\log(x)$
Curve fit for extrapolation (-1.200 < x < -0.400)
$\log(y) = 1.821 - 15.427x$

Curve fit for original data (0.196 < x < 0.450)
$\log(y) = -6.503 + 0.558x^2 - 6.672\log(x)$
Curve fit for extrapolation (0.450 < x < 1.362)
$\log(y) = -1.405 - 5.937x$

Curve fit for original data (-0.600 < x < -0.179)
$\log(y) = -2.662 - 5.582x^2 - 1.583\log(x)$
Curve fit for extrapolation (-0.800 < x < -0.600)
$\log(y) = 0.386 - 7.844x$

Curve fit for original data (0.161 < x < 0.800)
$\log(y) = -2.675 - 2.793x^2 - 2.149\log(x)$
Curve fit for extrapolation (0.800 < x < 1.600)
$\log(y) = 0.254 - 5.635x$

Figure C-2 Load Spectra for Airplane 12B[1], Single-Engine, Basic Flight Instruction



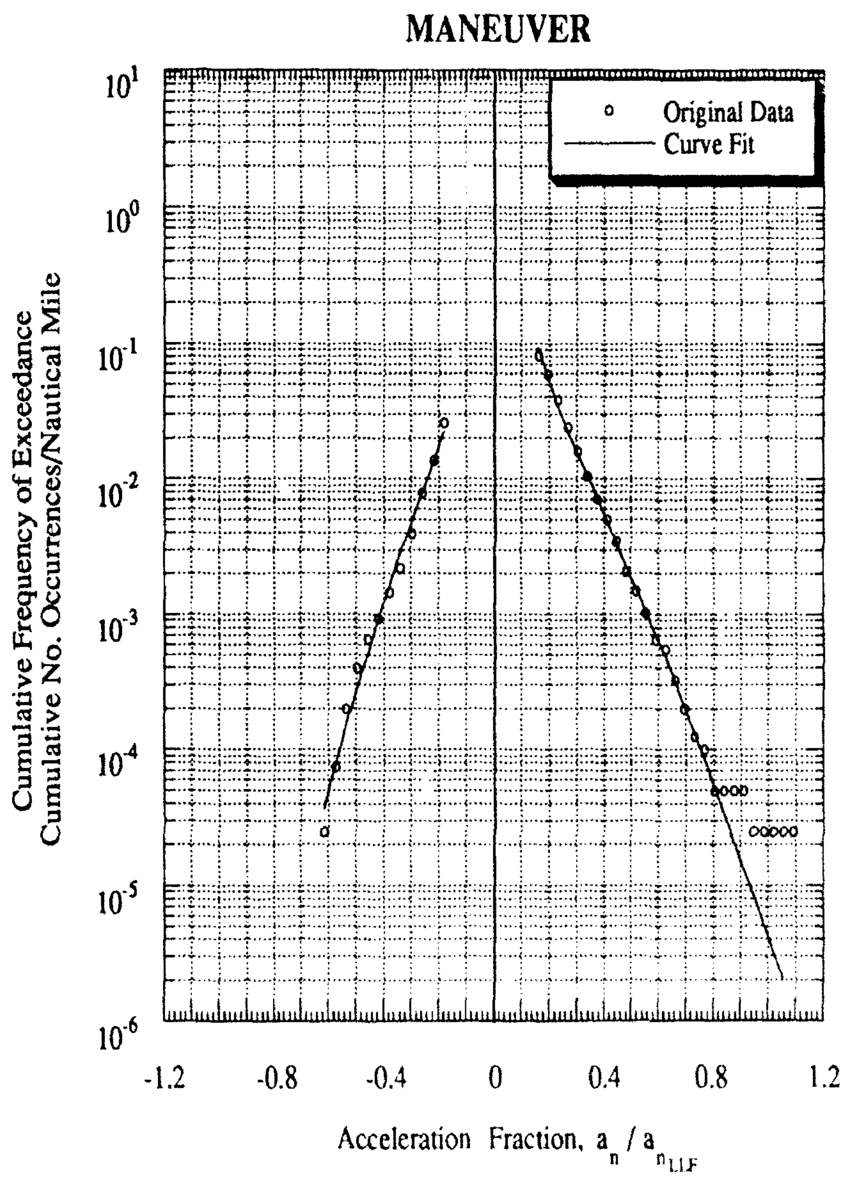


Table C-3 Tabulated Data for Airplane 12B^2

Total Nautical Miles = 64872 Total Hours = 7[illegible]4

GUST negative Acceleration Fraction	GUST negative Cumulative Frequency of Exceedance	GUST positive Acceleration Fraction	GUST positive Cumulative Frequency of Exceedance	MANEUVER negative Acceleration Fraction	MANEUVER negative Cumulative Frequency of Exceedance	MANEUVER positive Acceleration Fraction	MANEUVER positive Cumulative Frequency of Exceedance
-0.200	0.0942538	0.200	0.0650243	-0.200	0.0098082	0.150	0.0818813
-0.250	0.0180708	0.250	0.0161310	-0.250	0.0033519	0.200	0.0336556
-0.300	0.0046374	0.300	0.0047688	-0.300	0.0013412	0.250	0.0166524
-0.350	0.0014527	0.350	0.0015698	-0.350	0.0005944	0.3[illegible]0	0.0092383
-0.400	0.0005257	0.400	0.0005525	-0.400	0.0002823	0.350	0.0055328
-0.450	0.0002122	0.450	0.0002026	-0.450	0.0001407	0.400	0.0034972
-0.500	0.9318E-04	0.500	0.7599E-04	-0.500	0.7245E-04	0.450	0.0022992
-0.550	0.4378E-04	0.550	0.2880E-04	-0.550	0.3817E-04	0.500	0.0015566
-0.600	0.2172E-04	0.600	0.1094E-04	-0.600	0.2029E-04	0.550	0.0010776
		0.650	0.4152E-05			0.600	0.0007588
						0.650	0.0005413
						0.700	0.0003901
						0.750	0.0002832
						0.800	0.0002067
						0.850	0.0001515
						0.900	0.0001113
						0.950	0.8181E-04
						1.000	0.6016E-04
						1.050	0.4423E-04
						1.100	0.3253E-04
						1.150	0.2392E-04

NOTE: for curve fits x = |x|

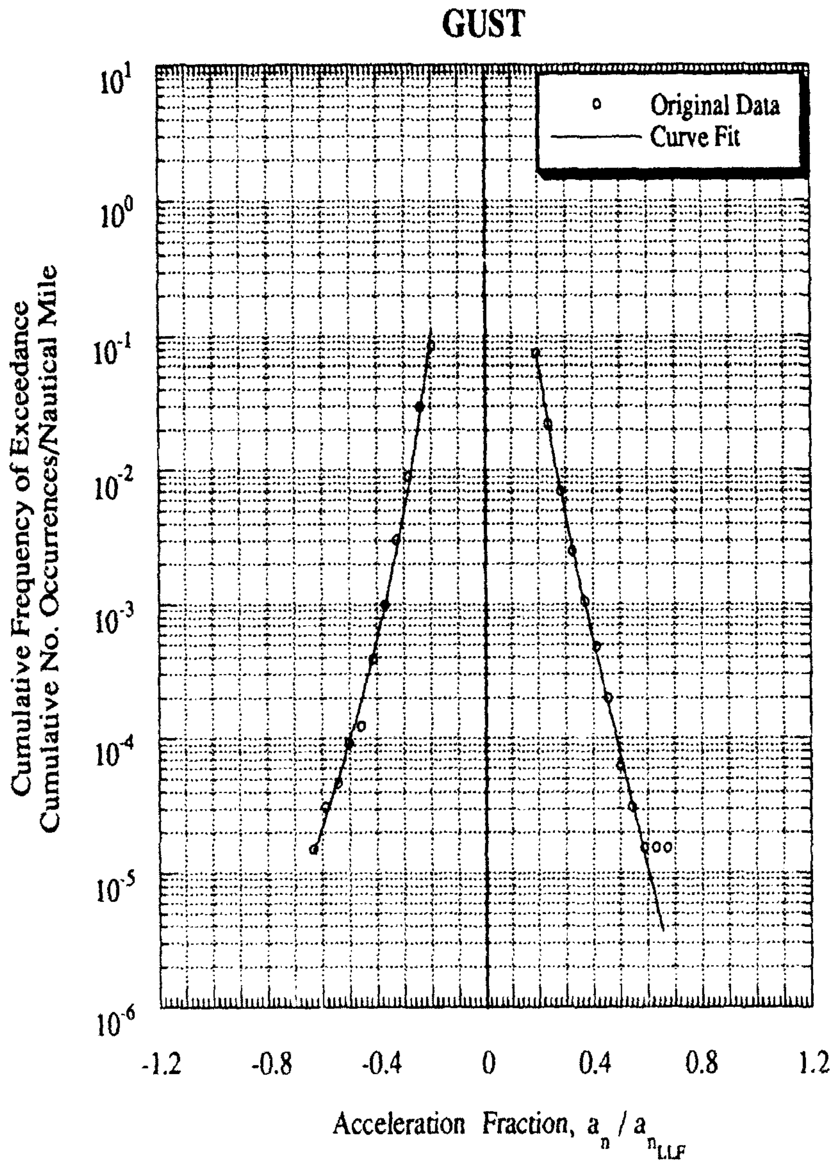
GUST negative
Curve fit for original data ($-0.600<x<-0.196$)
$\log(y) = -6.097 - 0.505x^2 - 7.285\log(x)$
Curve fit for extrapolation ($-1.200<x<-0.600$)
$\log(y) = -1.136 - 5.879x$

GUST positive
Curve fit for original data ($0.196<x<0.550$)
$\log(y) = -4.786 - 3.795x^2 - 5.366\log(x)$
Curve fit for extrapolation ($0.550<x<1.362$)
$\log(y) = 0.086 - 8.412x$

MANEUVER negative
Curve fit for original data ($-0.550<x<-0.179$)
$\log(y) = -4.999 - 1.844x^2 - 4.384\log(x)$
Curve fit for extrapolation ($-0.800<x<-0.550$)
$\log(y) = -1.399 - 5.489x$

MANEUVER positive
Curve fit for original data ($0.161<x<0.900$)
$\log(y) = -3.539 - 0.681x^2 - 2.995\log(x)$
Curve fit for extrapolation ($0.900<x<1.600$)
$\log(y) = -1.550 - 2.671x$

Figure C-3 Load Spectra for Airplane $12B^2$, Single-Engine, Basic Flight Instruction



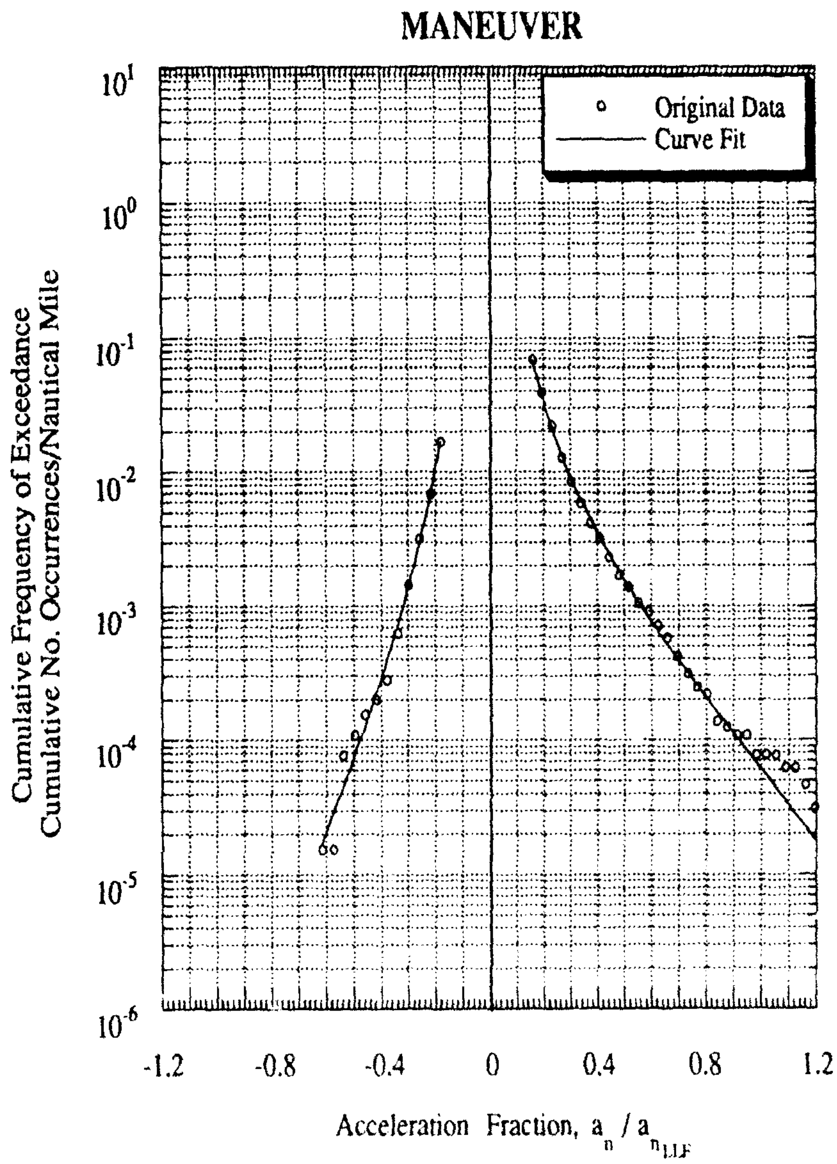


Table C-4 Tabulated Data for Airplane 14

Total Nautical Miles = 42187 Total Hours = 489

GUST				MANEUVER			
negative		positive		negative		positive	
Acceleration Fraction	Cumulative Frequency of Exceedance	Acceleration Fraction	Cumulative Frequency of Exceedance	Acceleration Fraction	Cumulative Frequency of Exceedance	Acceleration Fraction	Cumulative Frequency of Exceedance
-0.150	0.0538474	0.150	0.0694722	-0.150	0.0156393	0.150	0.1628982
-0.200	0.0166849	0.200	0.0269236	-0.200	0.0049092	0.200	0.0684196
-0.250	0.0042529	0.250	0.0113497	-0.250	0.0017549	0.250	0.0337538
-0.300	0.0008719	0.300	0.0049142	-0.300	0.0006631	0.300	0.0183085
-0.350	0.0001420	0.350	0.0021195	-0.350	0.0002545	0.350	0.0105406
		0.400	0.0008942	-0.400	0.9691E-04	0.400	0.0063070
		0.450	0.0003646	-0.450	0.3605E-04	0.450	0.0038693
		0.500	0.0001426			0.500	0.0024114
		0.550	0.5316E-04			0.550	0.0015166
		0.600	0.1932E-04			0.600	0.0009579
						0.650	0.0006053
						0.700	0.0003816
						0.750	0.0002395
						0.800	0.0001493
						0.850	0.9235E-04
						0.900	0.5660E-04

NOTE: *for curve fits* $x = |x|$

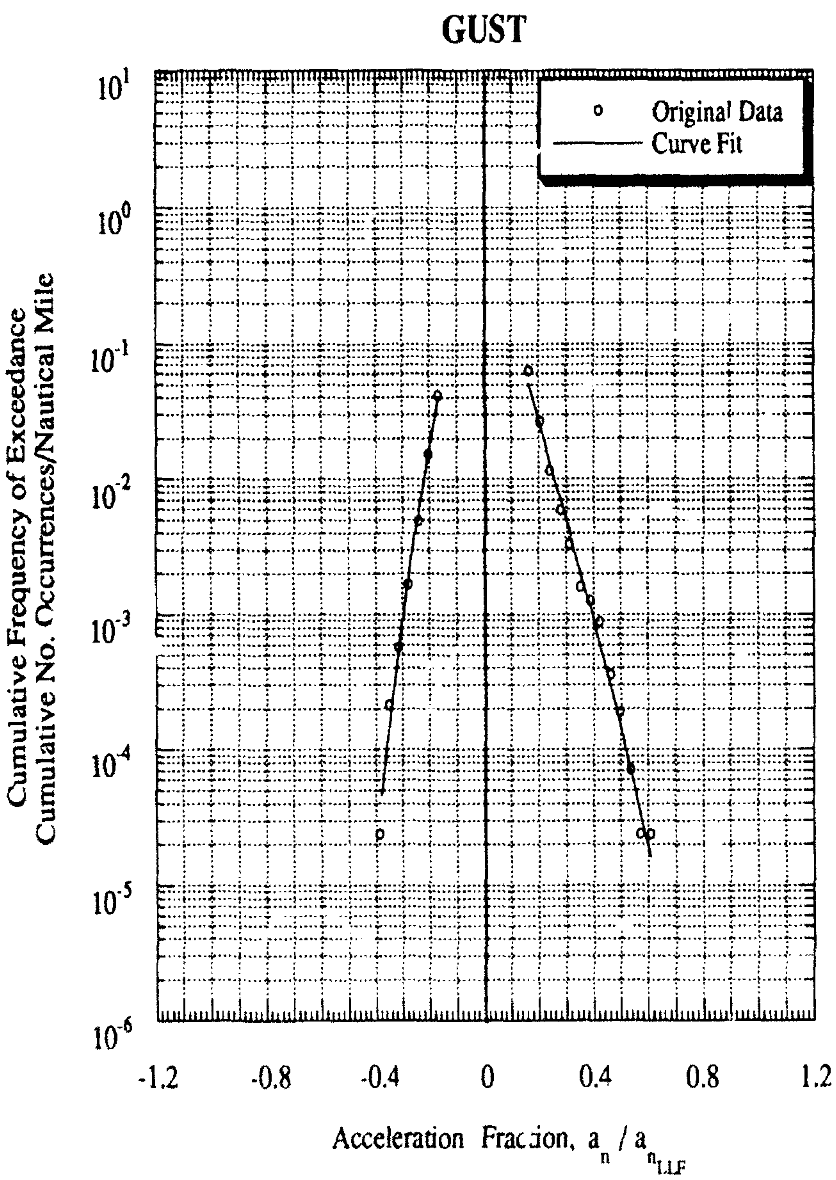
Curve fit for original data $(-0.350 < x < -0.166)$
$\log(y) = -1.551 - 22.290x^2 - 0.951\log(x)$
Curve fit for extrapolation $(-1.200 < x < -0.350)$
$\log(y) = 2.026 - 16.782x$

Curve fit for original data $(0.166 < x < 0.550)$
$\log(y) = -3.010 - 6.254x^2 - 2.419\log(x)$
Curve fit for extrapolation $(0.550 < x < 1.362)$
$\log(y) = 0.560 - 8.790x$

Curve fit for original data $(-0.450 < x < -0.155)$
$\log(y) = -4.252 - 6.$[illegible]$24x^2 - 3.142\log(x)$
Curve fit for extrapolation $(-0.800 < x < -0.450)$
$\log(y) = -0.518 - 8.723x$

Curve fit for original data $(0.161 < x < 0.900)$
$\log(y) = -3.046 - 1.640x^2 - 2.786\log(x)$
Curve fit for extrapolation $(0.900 < x < 1.600)$
$\log(y) = -0.381 - 4.296x$

Figure C-4 Load Spectra for Airplane 14, Single-Engine, Basic Flight Instruction



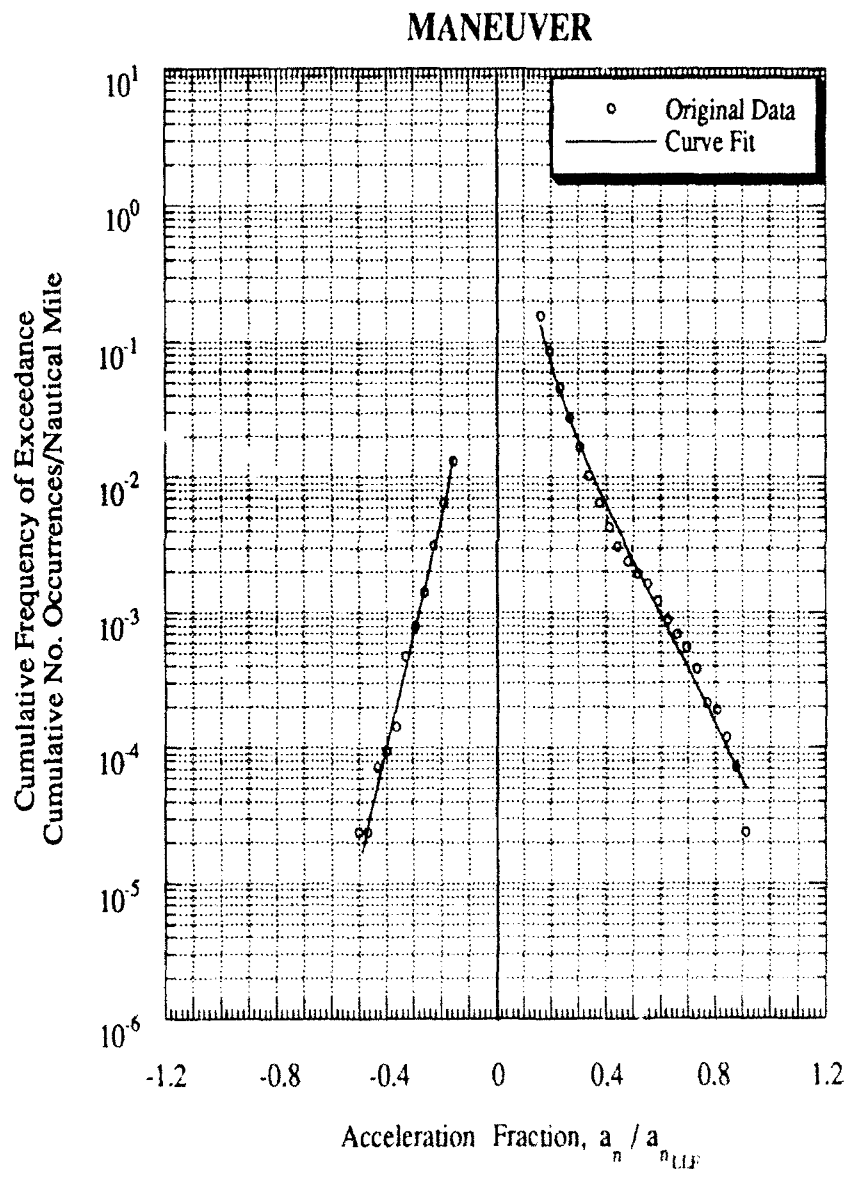


Table C-5 Tabulated Data for Airplane 14A

Total Nautical Miles = 80902 Total Hours = 935

GUST				MANEUVER			
negative		positive		negative		positive	
Acceleration Fraction	Cumulative Frequency of Exceedance	Acceleration Fraction	Cumulative Frequency of Exceedance	Acceleration Fraction	Cumulative Frequency of Exceedance	Acceleration Fraction	Cumulative Frequency of Exceedance
-0.150	0.0700234	0.150	0.0770067	-0.150	0.0242992	0.150	0.0384667
-0.200	0.0107510	0.200	0.0122008	-0.200	0.0066564	0.200	0.0121672
-0.250	0.0020048	0.250	0.0027875	-0.250	0.0019044	0.250	0.0047734
-0.300	0.0004036	0.300	0.0007950	-0.300	0.0005323	0.300	0.0021272
-0.350	0.8234E-04	0.350	0.0002621	-0.350	0.0001402	0.350	0.0010274
		0.400	0.9538E-04			0.400	0.0005229
		0.450	0.3720E-04			0.450	0.0002755
						0.500	0.0001484
						0.550	0.8053E-04
						0.600	0.4372E-04
						0.650	0.2373E-04

NOTE: for curve fits $x = |x|$

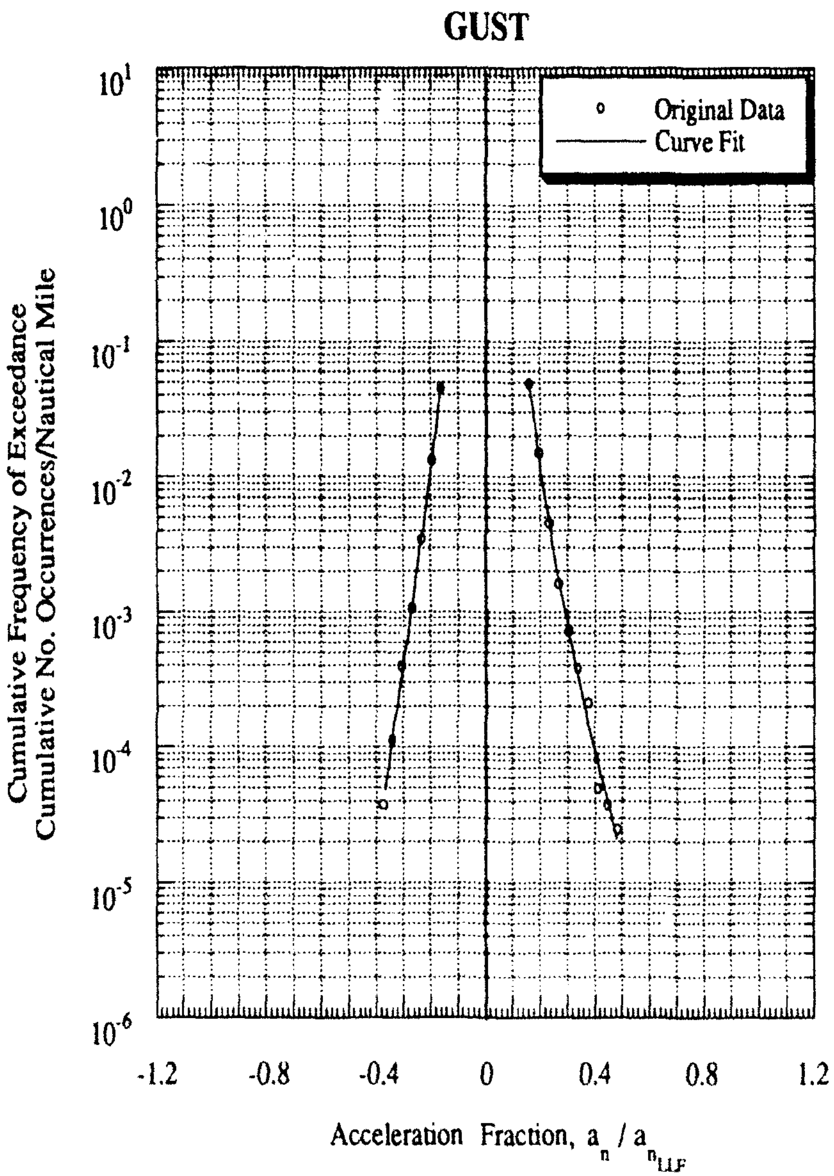
Curve fit for original data $(-0.350 < x < -0.161)$
$\log(y) = -5.005 - 10.995x^2 - 4.973\log(x)$
Curve fit for extrapolation $(-1.200 < x < -0.350)$
$\log(y) = 0.769 - 13.868x$

Curve fit for original data $(0.161 < x < 0.450)$
$\log(y) = -6.073 - 2.301x^2 - 6.082\log(x)$
Curve fit for extrapolation $(0.450 < x < 1.362)$
$\log(y) = -0.856 - 7.940x$

Curve fit for original data $(-0.350 < x < -0.155)$
$\log(y) = -3.665 - 12.019x^2 - 2.817\log(x)$
Curve fit for extrapolation $(-0.800 < x < -0.350)$
$\log(y) = 0.315 - 11.910x$

Curve fit for original data $(0.132 < x < 0.500)$
$\log(y) = -4.424 - 2.085x^2 - 3.709\log(x)$
Curve fit for extrapolation $(0.500 < x < 1.600)$
$\log(y) = -1.175 - 5.307x$

Figure C-5 Load Spectra for Airplane 14A, Single-Engine, Basic Flight Instruction



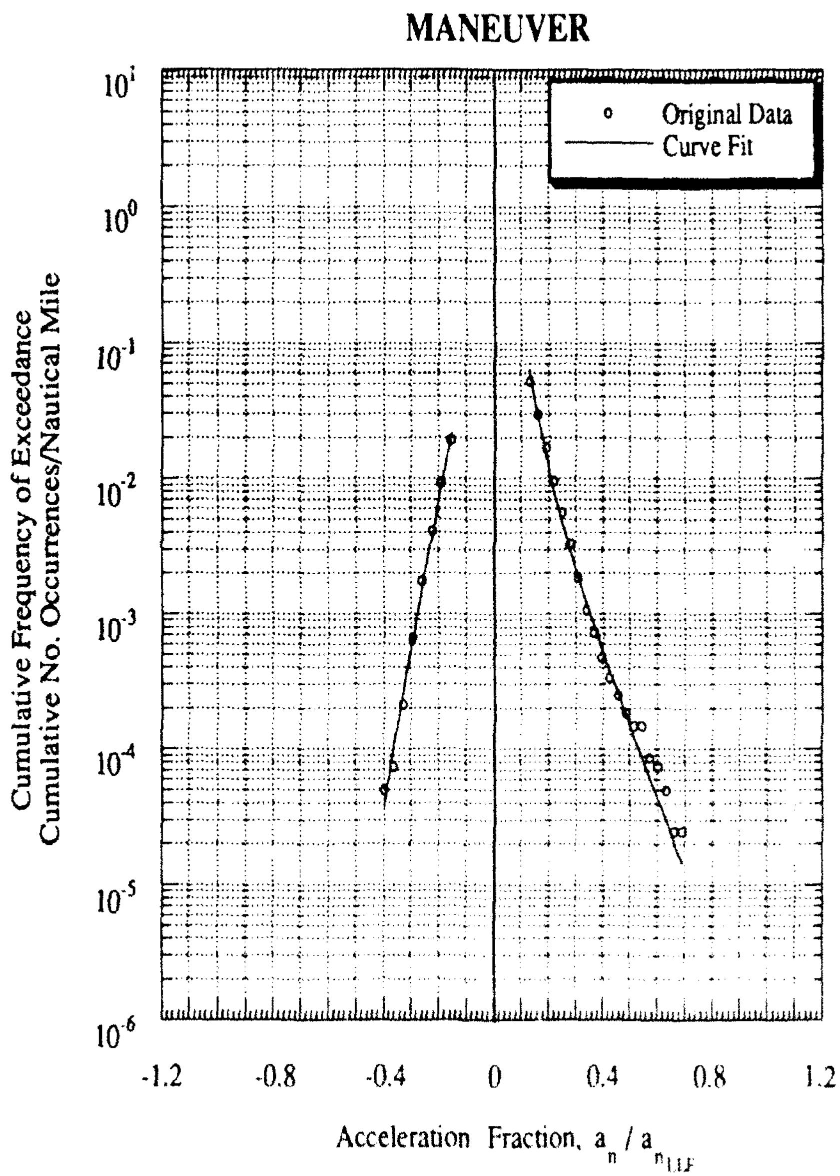


Table C-6 Tabulated Data for Airplane 15

Total Nautical Miles = 19057   Total Hours = 219

GUST				MANEUVER			
negative		positive		negative		positive	
Acceleration Fraction	Cumulative Frequency of Exceedance	Acceleration Fraction	Cumulative Frequency of Exceedance	Acceleration Fraction	Cumulative Frequency of Exceedance	Acceleration Fraction	Cumulative Frequency of Exceedance
-0.200	0.0143388	0.200	0.0144228	-0.200	0.0175959	0.150	0.1161324
-0.250	0.0026009	0.250	0.0030968	-0.250	0.0055450	0.200	0.0447494
-0.300	0.0006536	0.300	0.0005875	-0.300	0.0015690	0.250	0.0197129
-0.350	0.0002062			-0.350	0.0003904	0.300	0.0092965
-0.400	0.7699E-04			-0.400	0.8438E-04	0.350	0.0045319
-0.450	0.3084E-04					0.400	0.0022364
						0.450	0.0011022
						0.500	0.0005376
						0.550	0.0002578
						0.600	0.0001223
						0.650	0.5806E-04
						0.700	0.2756E-04
						0.750	0.1308E-04
						0.800	0.6207E-05
						0.850	0.2946E-05
						0.900	0.1398E-05

NOTE: for curve fits $x = |x|$

Curve fit for original data $(-0.400 < x < -0.183)$
$\log(y) = -7.324 + 0.656x^2 - 7.803\log(x)$
Curve fit for extrapolation $(-1.200 < x < -0.400)$
$\log(y) = -0.935 - 7.947x$

Curve fit for original data $(0.183 < x < 0.300)$
$\log(y) = -2.755 - 19.305x^2 - 2.412\log(x)$
Curve fit for extrapolation $(0.300 < x < 1.362)$
$\log(y) = 1.292 - 15.075x$

Curve fit for original data $(-0.400 < x < -0.179)$
$\log(y) = -2.298 - 15.194x^2 - 1.647\log(x)$
Curve fit for extrapolation $(-0.800 < x < -0.400)$
$\log(y) = 1.504 - 13.944x$

Curve fit for original data $(0.173 < x < 0.550)$
$\log(y) = -3.129 - 3.897x^2 - 2.769\log(x)$
Curve fit for extrapolation $(0.550 < x < 1.600)$
$\log(y) = -0.028 - 6.473x$

Figure C-6 Load Spectra for Airplane 15, Single-Engine, Basic Flight Instruction

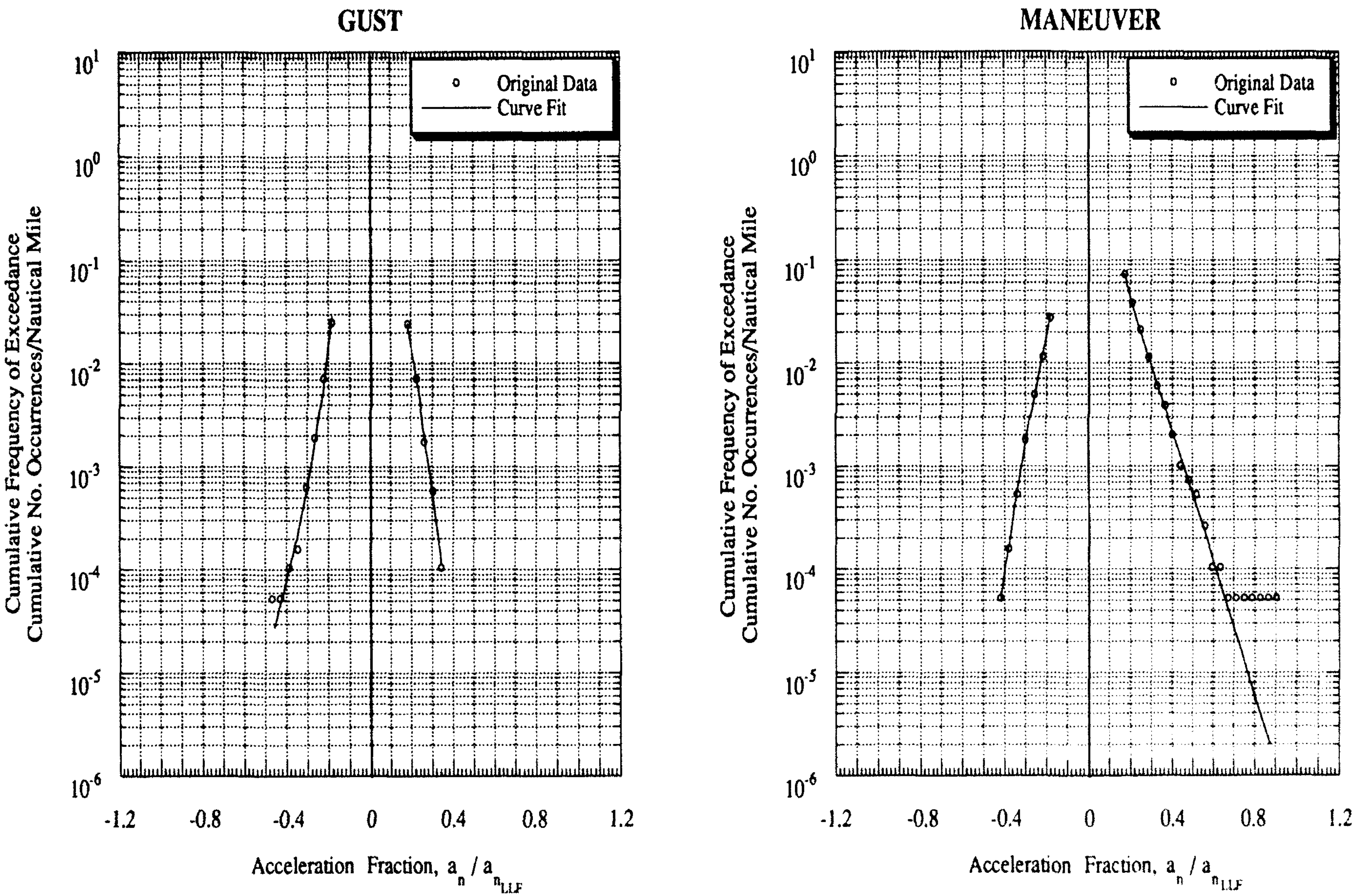


Table C-7 Tabulated Data for Airplane 16

Total Nautical Miles = 37420 Total Hours = 494

GUST				MANEUVER			
negative		positive		negative		positive	
Acceleration Fraction	Cumulative Frequency of Exceedance	Acceleration Fraction	Cumulative Frequency of Exceedance	Acceleration Fraction	Cumulative Frequency of Exceedance	Acceleration Fraction	Cumulative Frequency of Exceedance
-0.250	0.0152106	0.250	0.0197320	-0.150	0.0244972	0.150	0.0275445
-0.300	0.0025976	0.300	0.0040192	-0.200	0.0042480	0.200	0.0130013
-0.350	0.0006230	0.350	0.0010235	-0.250	0.0009644	0.250	0.0066527
-0.400	0.0001935	0.400	0.0003059	-0.300	0.0002531	0.300	0.0035184
-0.450	0.7379E-04	0.450	0.0001030			0.350	0.0018749
		0.500	0.3804E-04			0.400	0.0009915
						0.450	0.0005153
						0.500	0.0002614
						0.550	0.0001288
						0.600	0.6147E-04

NOTE: for curve fits $x = |x|$

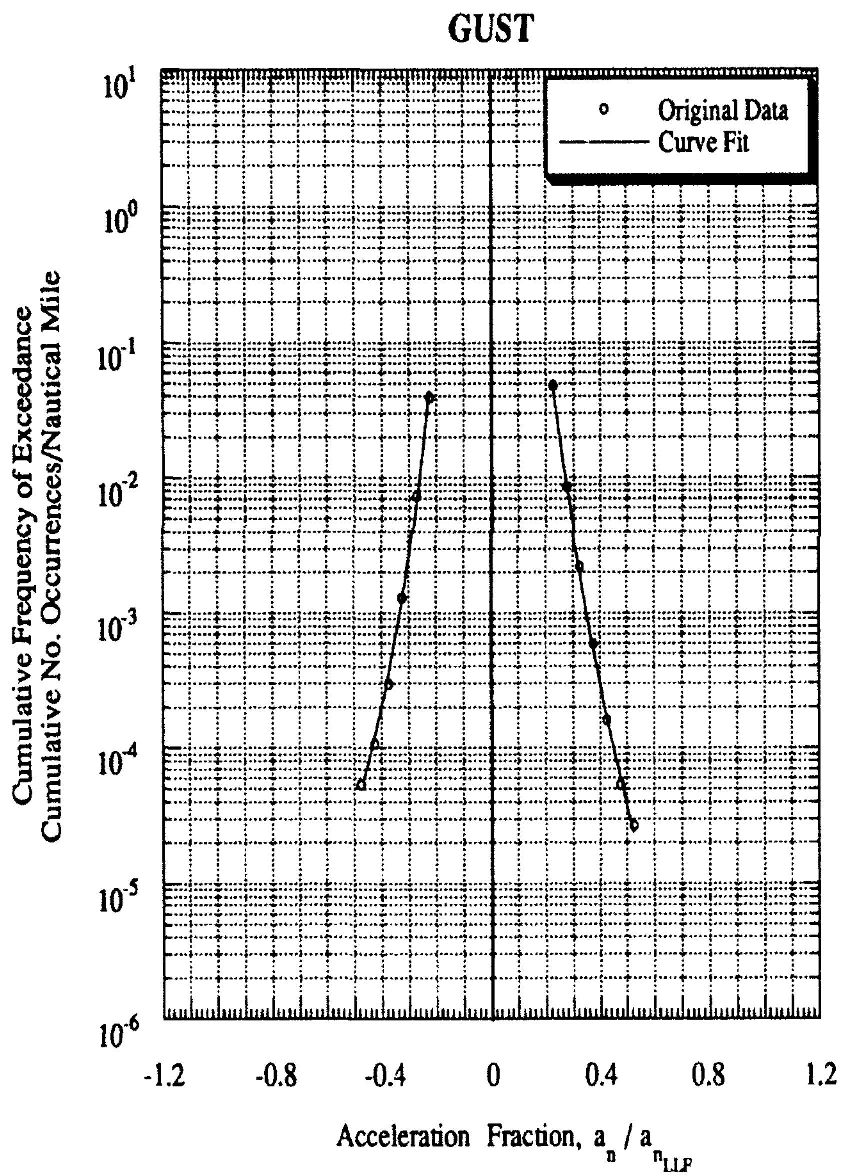
Curve fit for original data $(-0.450 < x < -0.225)$
$\log(y) = -8.503 + 3.125x^2 - 10.779\log(x)$
Curve fit for extrapolation $(-1.200 < x < -0.450)$
$\log(y) = -0.7[illegible]6 - 7.591x$

Curve fit for original data $(0.225 < x < 0.500)$
$\log(y) = -6.672 - 1.058x^2 - 8.360\log(x)$
Curve fit for extrapolation $(0.500 < x < 1.362)$
$\log(y) = -0.260 - 8.319x$

Curve fit for original data $(-0.300 < x < -0.163)$
$\log(y) = -5.799 - 6.018x^2 - 5.248\log(x)$
Curve fit for extrapolation $(-0.800 < x < -0.300)$
$\log(y) = -0.235 - 11.207x$

Curve fit for original data $(0.132 < x < 0.600)$
$\log(y) = -3.122 - 4.267x^2 - 2.012\log(x)$
Curve fit for extrapolation $(0.600 < x < 1.600)$
$\log(y) = -0.266 - 6.576x$

Figure C-7 Load Spectra for Airplane 16, Single-Engine, Basic Flight Instruction



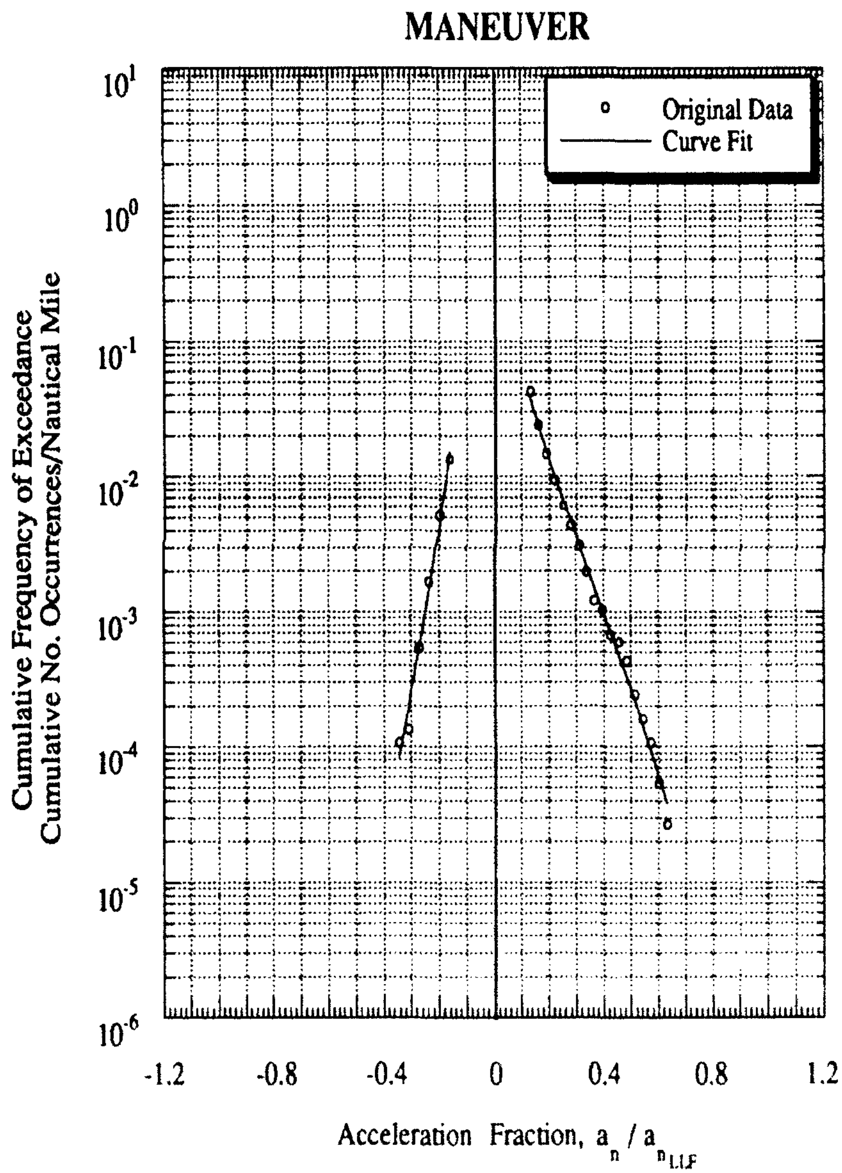


Table C-8 Tabulated Data for Airplane 17

Total Nautical Miles = 65991 Total Hours = 813

GUST negative Acceleration Fraction	GUST negative Cumulative Frequency of Exceedance	GUST positive Acceleration Fraction	GUST positive Cumulative Frequency of Exceedance	MANEUVER negative Acceleration Fraction	MANEUVER negative Cumulative Frequency of Exceedance	MANEUVER positive Acceleration Fraction	MANEUVER positive Cumulative Frequency of Exceedance
-0.200	0.0295015	0.200	0.0319050	-0.150	0.0249842	0.150	0.0305492
-0.250	0.0065111	0.250	0.0067451	-0.200	0.0109160	0.200	0.0167716
-0.300	0.0020237	0.300	0.0019772	-0.250	0.0041082	0.250	0.0092434
-0.350	0.0008056	0.350	0.0007314	-0.300	0.0013132	0.300	0.0049712
-0.400	0.0003881	0.400	0.0003229	-0.350	0.0003538	0.350	0.0025699
-0.450	0.0002182	0.450	0.0001640	-0.400	0.8000E-04	0.400	0.0012655
-0.500	0.0001396	0.500	0.9351E-04	-0.450	0.1513E-04	0.450	0.0005902
-0.550	0.9468E-04	0.550	0.5614E-04	-0.500	0.2617E-05	0.500	0.0002597
-0.600	0.6421E-04	0.600	0.3371E-04			0.550	0.0001075
-0.650	0.4355E-04	0.650	0.2024E-04			0.600	0.4174E-04
-0.700	0.2953E-04	0.700	0.1215E-04				
-0.750	0.2003E-04	0.750	0.7294E-05				
		0.800	0.4379E-05				
		0.850	0.2629E-05				
		0.900	0.1578E-05				

NOTE: for curve fits x = |x|

Curve fit for original data (-0.500 < x < -0.183)
$\log(y) = -6.899 + 3.142x^2 - 7.501\log(x)$
Curve fit for extrapolation (-1.200 < x < -0.500)
$\log(y) = -2.169 - 3.373x$

Curve fit for original data (0.183 < x < 0.500)
$\log(y) = -6.773 + 2.026x^2 - 7.434\log(x)$
Curve fit for extrapolation (0.500 < x < 1.362)
$\log(y) = -1.813 - 4.432x$

Curve fit for original data (-0.450 < x < -0.163)
$\log(y) = -1.726 - 16.298x^2 - 0.595\log(x)$
Curve fit for extrapolation (-0.800 < x < -0.450)
$\log(y) = 2.039 - 15.243x$

Curve fit for original data (0.132 < x < 0.600)
$\log(y) = -2.356 - 6.357x^2 - 1.194\log(x)$
Curve fit for extrapolation (0.600 < x < 1.600)
$\log(y) = 0.716 - 8.493x$

Figure C-8 Load Spectra for Airplane 17, Single-Engine, Basic Flight Instruction

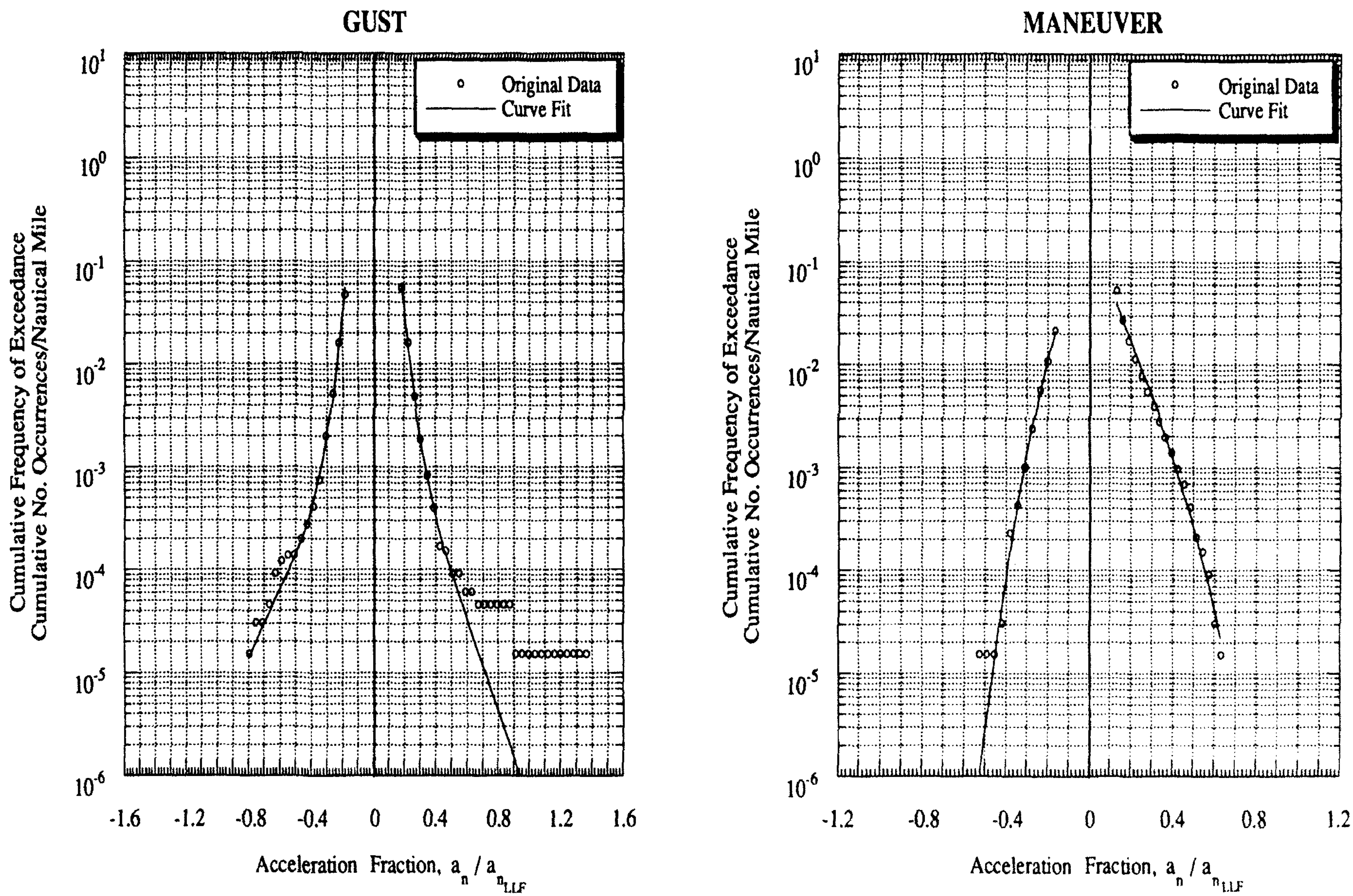


Table C-9 Tabulated Data for Airplane 18

Total Nautical Miles = 6962 Total Hours = 96

GUST				MANEUVER			
negative		positive		negative		positive	
Acceleration Fraction	Cumulative Frequency of Exceedance	Acceleration Fraction	Cumulative Frequency of Exceedance	Acceleration Fraction	Cumulative Frequency of Exceedance	Acceleration Fraction	Cumulative Frequency of Exceedance
-0.200	0.0362789	0.200	0.0261791	-0.200	0.0241158	0.150	0.0290961
-0.250	0.0094288	0.250	0.0104489	-0.250	0.0082690	0.200	0.0142185
-0.300	0.0027717	0.300	0.0039668	-0.300	0.0022441	0.250	0.0068914
-0.350	0.0008686	0.350	0.0014019	-0.350	0.0004818	0.300	0.0032093
		0.400	0.0004553			0.350	0.0014119
						0.400	0.0005809
						0.450	0.0002306
						0.500	0.9153E-04
						0.550	0.3633E-04
						0.600	0.1442E-04

NOTE: for curve fits $x = |x|$

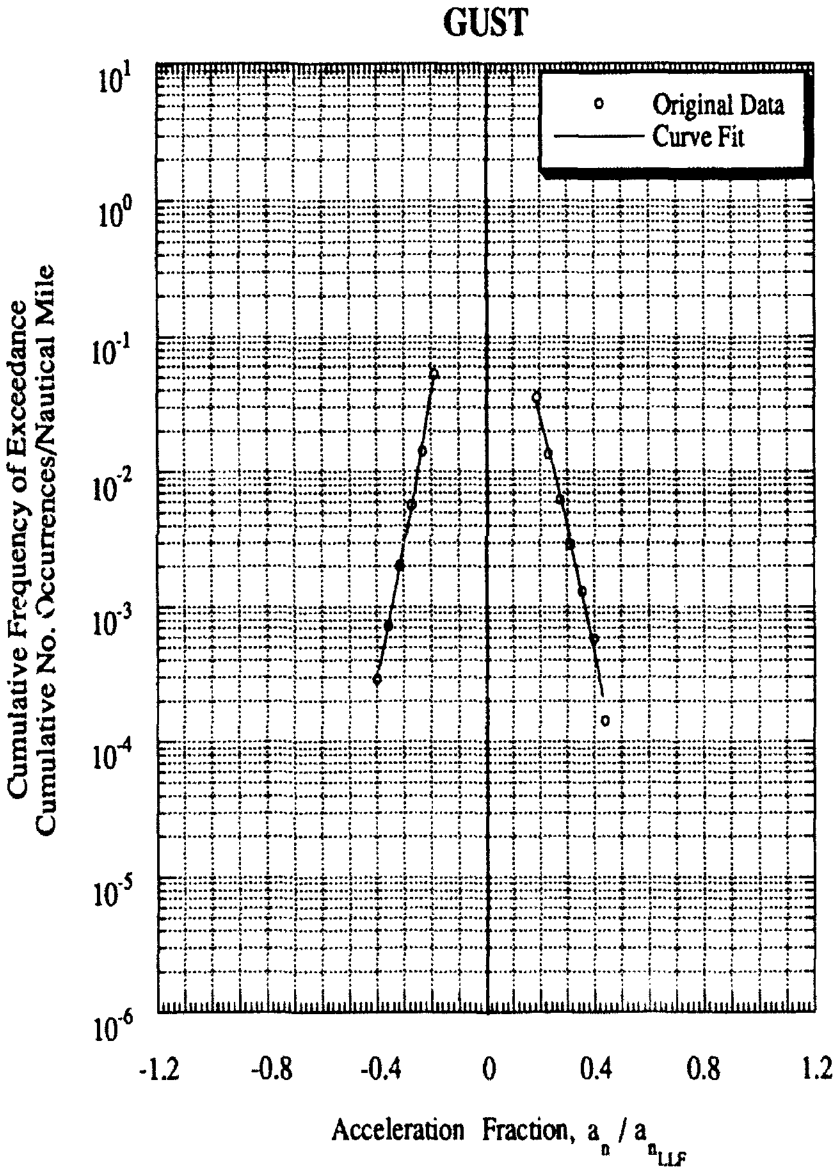
Curve fit for original data $(-0.350 < x < -0.189)$
$\log(y) = -4.472 - 5.877x^2 - 4.674\log(x)$
Curve fit for extrapolation $(-1.200 < x < -0.350)$
$\log(y) = 0.409 - 9.914x$

Curve fit for original data $(0.189 < x < 0.400)$
$\log(y) = -2.357 - 10.390x^2 - 1.704\log(x)$
Curve fit for extrapolation $(0.400 < x < 1.362)$
$\log(y) = 0.723 - 10.162x$

Curve fit for original data $(-0.350 < x < -0.205)$
$\log(y) = -0.830 - 20.469x^2 - 0.044\log(x)$
Curve fit for extrapolation $(-0.800 < x < -0.350)$
$\log(y) = 1.717 - 14.383x$

Curve fit for original data $(0.128 < x < 0.400)$
$\log(y) = -2.454 - 8.216x^2 - 1.338\log(x)$
Curve fit for extrapolation $(0.400 < x < 1.600)$
$\log(y) = -0.026 - 8.026x$

Figure C-9 Load Spectra for Airplane 18, Single-Engine, Basic Flight Instruction



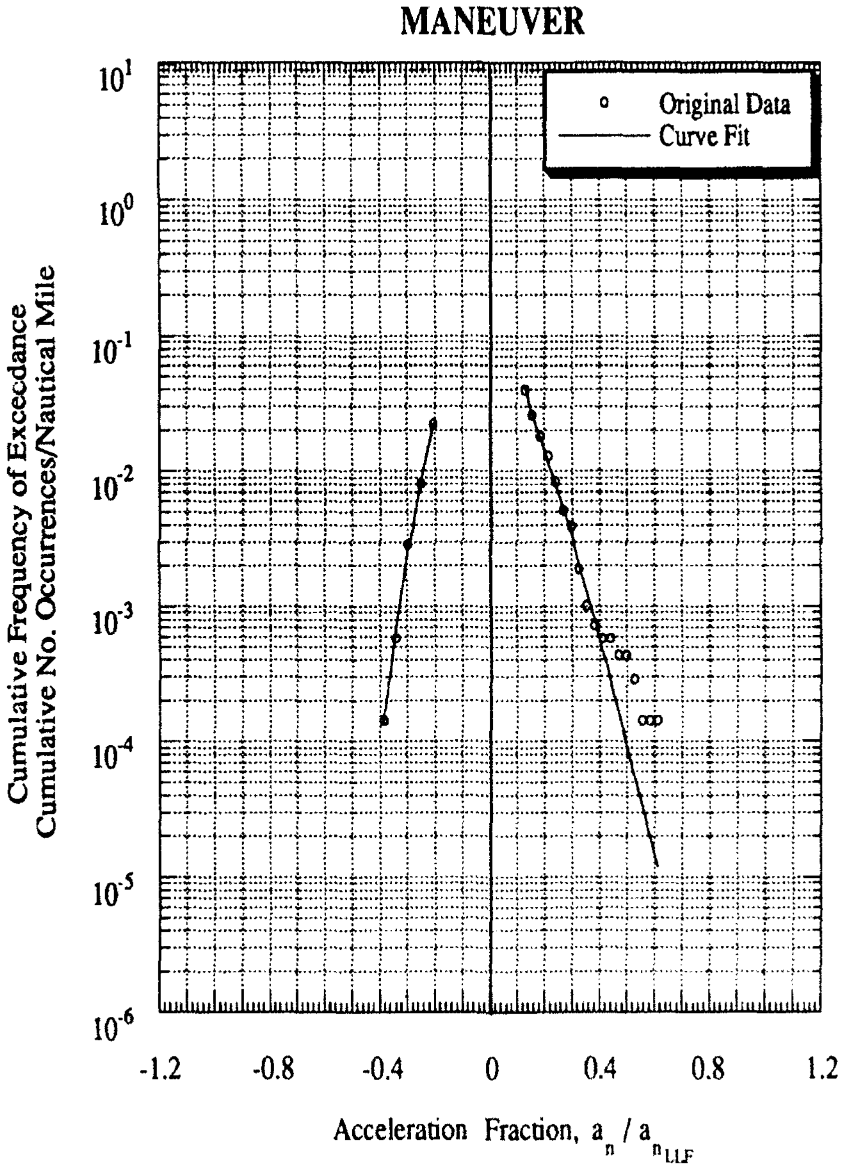


Table C-10 Tabulated Data for Airplane 18[1]

Total Nautical Miles = 68764 Total Hours = 911

GUST				MANEUVER			
negative		positive		negative		positive	
Acceleration Fraction	Cumulative Frequency of Exceedance	Acceleration Fraction	Cumulative Frequency of Exceedance	Acceleration Fraction	Cumulative Frequency of Exceedance	Acceleration Fraction	Cumulative Frequency of Exceedance
-0.200	0.0133911	0.200	0.0184174	-0.200	0.0325233	0.150	0.0249533
-0.250	0.0020525	0.250	0.0032458	-0.250	0.0108295	0.200	0.0122948
-0.300	0.0004037	0.300	0.0007283	-0.300	0.0032003	0.250	0.0060965
-0.350	0.9283E-04	0.350	0.0001906	-0.350	0.0008248	0.300	0.0029415
		0.400	0.5519E-04	-0.400	0.0001834	0.350	0.0013563
				-0.450	0.3498E-04	0.400	0.0005913
						0.450	0.0002420
						0.500	0.9584E-04
						0.550	0.3795E-04
						0.600	0.1503E-04

NOTE: for curve fits x = |x|

Curve fit for original data $(-0.350<x<-0.189)$
$\log(y) = -6.845 - 4.463x^2 - 7.369\log(x)$
Curve fit for extrapolation $(-1.200<x<-0.350)$
$\log(y) = 0.261 - 12.268x$

Curve fit for original data $(0.189<x<0.400)$
$\log(y) = -6.440 - 3.622x^2 - 6.938\log(x)$
Curve fit for extrapolation $(0.400<x<1.362)$
$\log(y) = -0.086 - 10.431x$

Curve fit for original data $(-0.450<x<-0.205)$
$\log(y) = -1.844 - 15.270x^2 - 1.383\log(x)$
Curve fit for extrapolation $(-0.800<x<-0.450)$
$\log(y) = 2.329 - 15.078x$

Curve fit for original data $(0.128<x<0.450)$
$\log(y) = -2.607 - 7.416x^2 - 1.422\log(x)$
Curve fit for extrapolation $(0.450<x<1.600)$
$\log(y) = 0.005 - 8.047x$

Figure C-10 Load Spectra for Airplane 18[1], Single-Engine, Basic Flight Instruction

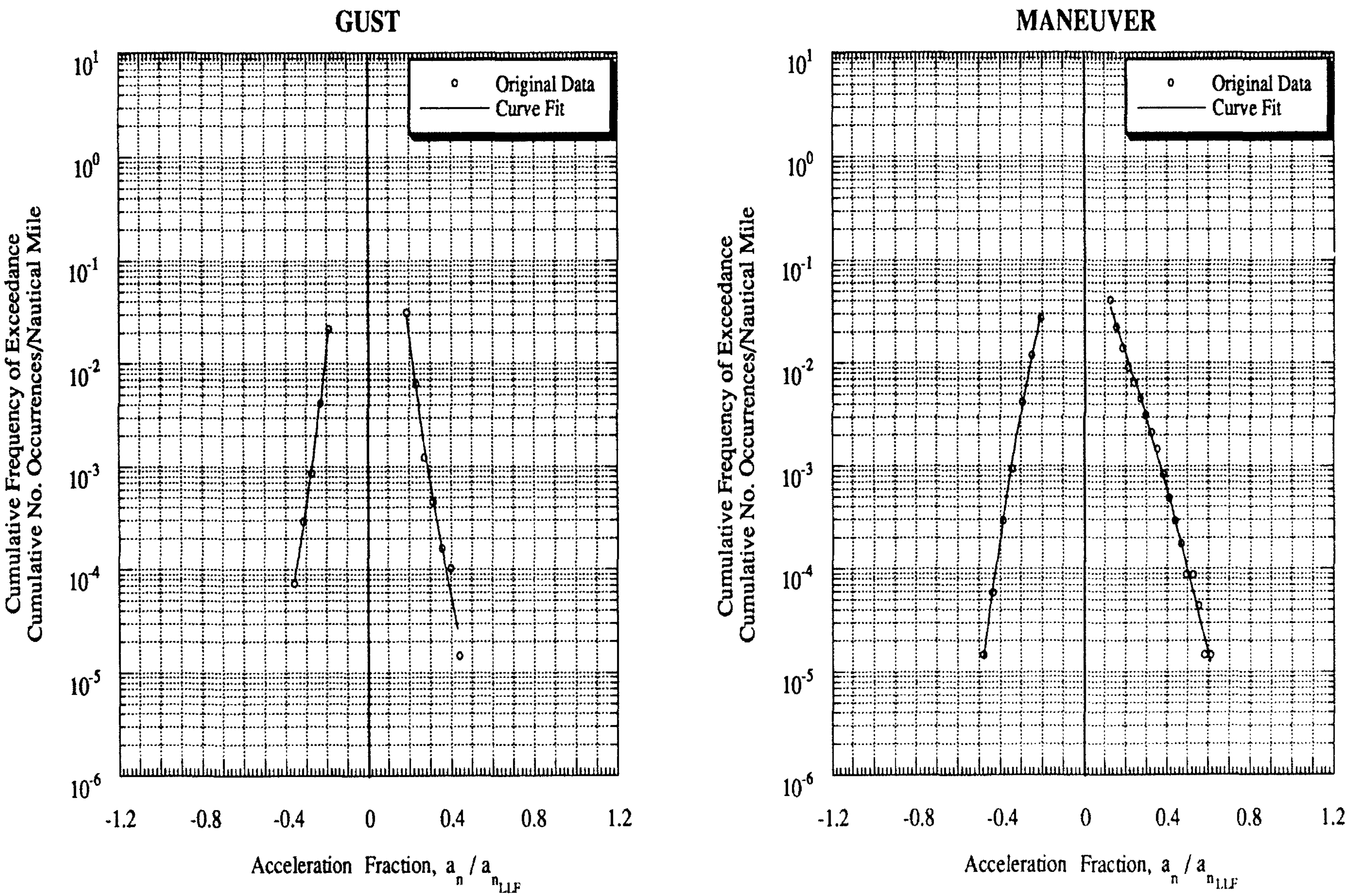


Table C-11 Tabulated Data for Airplane 6

Total Nautical Miles = 95867.7 | Total Hours = 584.2

GUST negative: Acceleration Fraction	GUST negative: Cumulative Frequency of Exceedance	GUST positive: Acceleration Fraction	GUST positive: Cumulative Frequency of Exceedance	MANEUVER negative: Acceleration Fraction	MANEUVER negative: Cumulative Frequency of Exceedance	MANEUVER positive: Acceleration Fraction	MANEUVER positive: Cumulative Frequency of Exceedance
-0.200	0.0121502	0.200	0.0139248	-0.200	0.0026230	0.150	0.0130789
-0.250	0.0030976	0.250	0.0046215	-0.250	0.0003948	0.200	0.0014472
-0.300	0.0009920	0.300	0.0014983	-0.300	0.8132E-04	0.250	0.0002077
-0.350	0.0003705	0.350	0.0004600			0.300	0.3347E-04
-0.400	0.0001543	0.400	0.0001313			0.350	0.5555E-05
-0.450	0.6969E-04	0.450	0.3442E-04				
-0.500	0.3345E-04						
-0.550	0.1683E-04						
-0.600	0.8637E-05						
-0.650	0.4432E-05						

NOTE: for curve fits x = |x|

GUST negative

Curve fit for original data (-0.550<x<-0.196)
$\log(y) = -5.985 - 1.045x^2 - 5.882\log(x)$
Curve fit for extrapolation (-1.200<x<-0.550)
$\log(y) = -1.587 - 5.794x$

GUST positive

Curve fit for original data (0.196<x<0.450)
$\log(y) = -3.141 - 10.729x^2 - 2.452\log(x)$
Curve fit for extrapolation (0.450<x<1.667)
$\log(y) = 0.947 - 12.023x$

MANEUVER negative

Curve fit for original data (-0.300<x<-0.179)
$\log(y) = -8.196 - 1.566x^2 - 8.122\log(x)$
Curve fit for extrapolation (-0.800<x<-0.300)
$\log(y) = -0.280 - 12.698x$

MANEUVER positive

Curve fit for original data (0.161<x<0.300)
$\log(y) = -6.618 - 11.384x^2 - 6.058\log(x)$
Curve fit for extrapolation (0.300<x<1.700)
$\log(y) = 0.205 - 15.600x$

Figure C-11 Load Spectra for Airplane 6, Single-Engine, Business/Personal

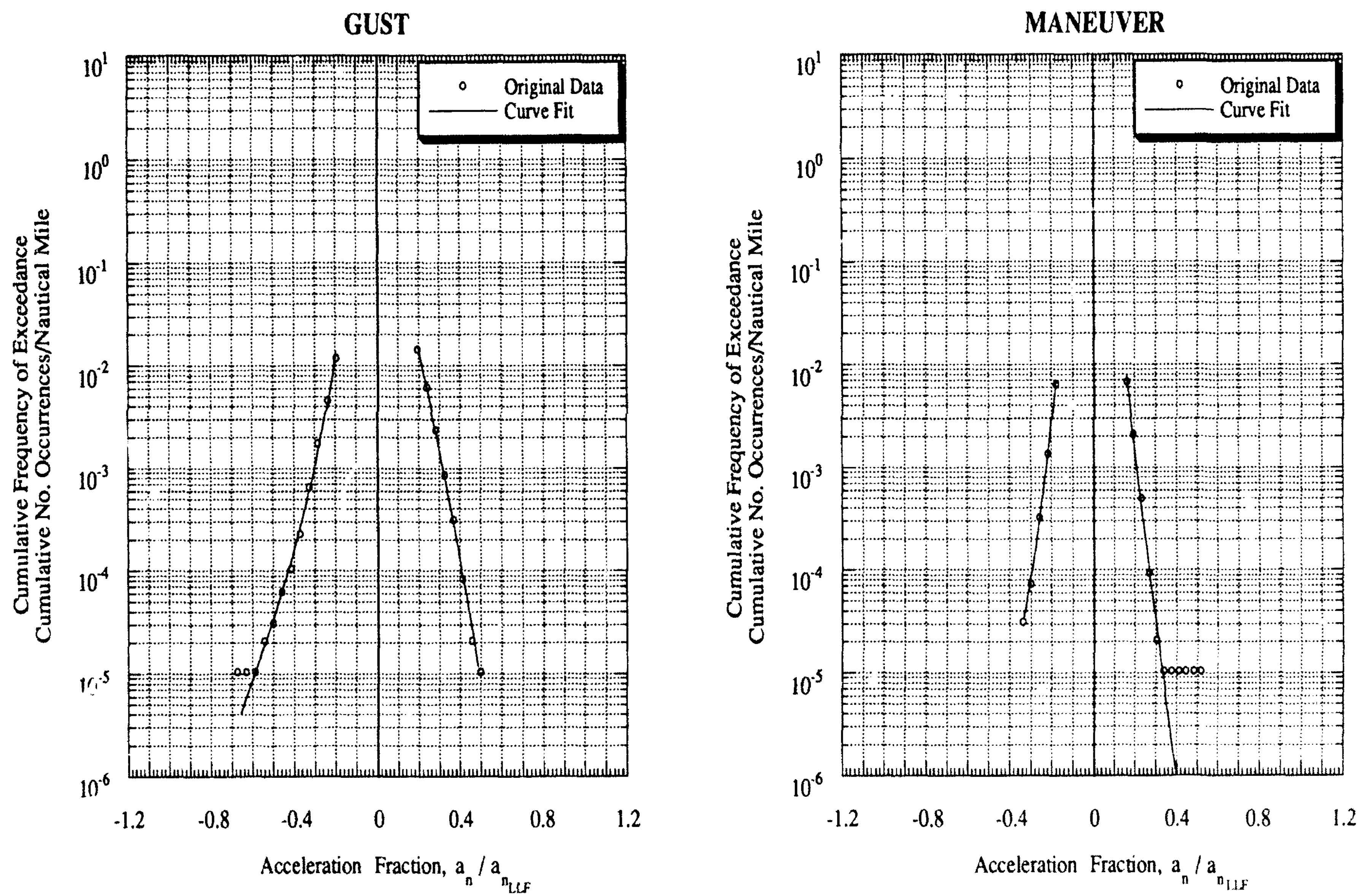


Table C-12 Tabulated Data for Airplane 7

Total Nautical Miles = 62631 Total Hours = 402

GUST				MANEUVER			
negative		positive		negative		positive	
Acceleration Fraction	Cumulative Frequency of Exceedance	Acceleration Fraction	Cumulative Frequency of Exceedance	Acceleration Fraction	Cumulative Frequency of Exceedance	Acceleration Fraction	Cumulative Frequency of Exceedance
-0.200	0.1759156	0.200	0.2360924	-0.150	0.0031642	0.150	0.0037965
-0.250	0.0730635	0.250	0.0874470	-0.200	0.0005700	0.200	0.0012826
-0.300	0.0296189	0.300	0.0351139	-0.250	0.0001530	0.250	0.0005069
-0.350	0.0114424	0.350	0.0146543	-0.300	0.5301E-04	0.300	0.0002173
-0.400	0.0041528	0.400	0.0061982			0.350	0.9704E-04
-0.450	0.0014029	0.450	0.0026141			0.400	0.4409E-04
-0.500	0.0004384	0.500	0.0010873			0.450	0.2006E-04
-0.550	0.0001262	0.550	0.0004424				
-0.600	0.3332E-04	0.600	0.0001751				
-0.650	0.8423E-05	0.650	0.6713E-04				
		0.700	0.2529E-04				
		0.750	0.9527E-05				

NOTE: for curve fits $x = |x|$

Curve fit for original data $(-0.600 < x < -0.190)$
$\log(y) = -1.724 - 8.813x^2 - 1.892\log(x)$
Curve fit for extrapolation $(-1.200 < x < -0.600)$
$\log(y) = 2.689 - 11.945x$

Curve fit for original data $(0.190 < x < 0.650)$
$\log(y) = -2.765 - 4.809x^2 - 3.334\log(x)$
Curve fit for extrapolation $(0.650 < x < 1.567)$
$\log(y) = 1.338 - 8.479x$

Curve fit for original data $(-0.300 < x < -0.163)$
$\log(y) = -7.504 + 0.695x^2 - 6.055\log(x)$
Curve fit for extrapolation $(-0.800 < x < -0.300)$
$\log(y) = -1.771 - 8.349x$

Curve fit for original data $(0.132 < x < 0.450)$
$\log(y) = -4.947 - 4.216x^2 - 3.182\log(x)$
Curve fit for extrapolation $(0.450 < x < 1.700)$
$\log(y) = -1.608 - 6.865x$

Figure C-12 Load Spectra for Airplane 7, Single-Engine, Business/Personal

GUST MANEUVER

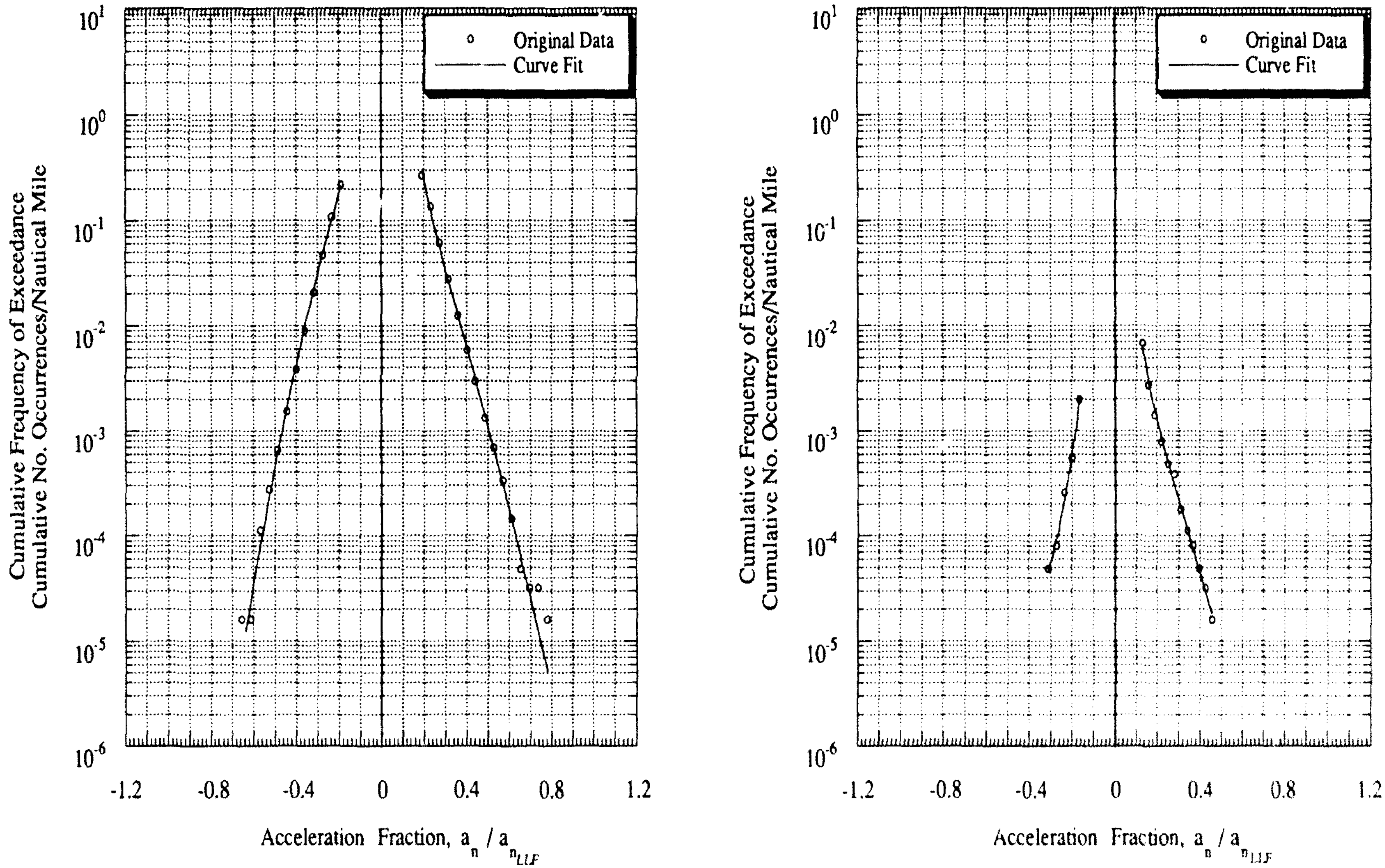


Table C-13 Tabulated Data for Airplane 7A

Total Nautical Miles = 2241 Total Hours = 15

GUST negative		GUST positive		MANEUVER negative		MANEUVER positive	
Acceleration Fraction	Cumulative Frequency of Exceedance	Acceleration Fraction	Cumulative Frequency of Exceedance	Acceleration Fraction	Cumulative Frequency of Exceedance	Acceleration Fraction	Cumulative Frequency of Exceedance
-0.200	0.0302626	0.200	0.0585052	-0.200	0.0015567	0.150	0.0201476
-0.250	0.0056093	0.250	0.0112109	-0.250	0.0007594	0.200	0.0092746
-0.300	0.0009633	0.300	0.0034956			0.250	0.0044202
		0.350	0.0015737			0.300	0.0020926
		0.400	0.0009525			0.350	0.0009792
		0.450	0.0006574			0.400	0.0004582
						0.450	0.0002144
						0.500	0.0001003

NOTE: for curve fits $x = |x|$

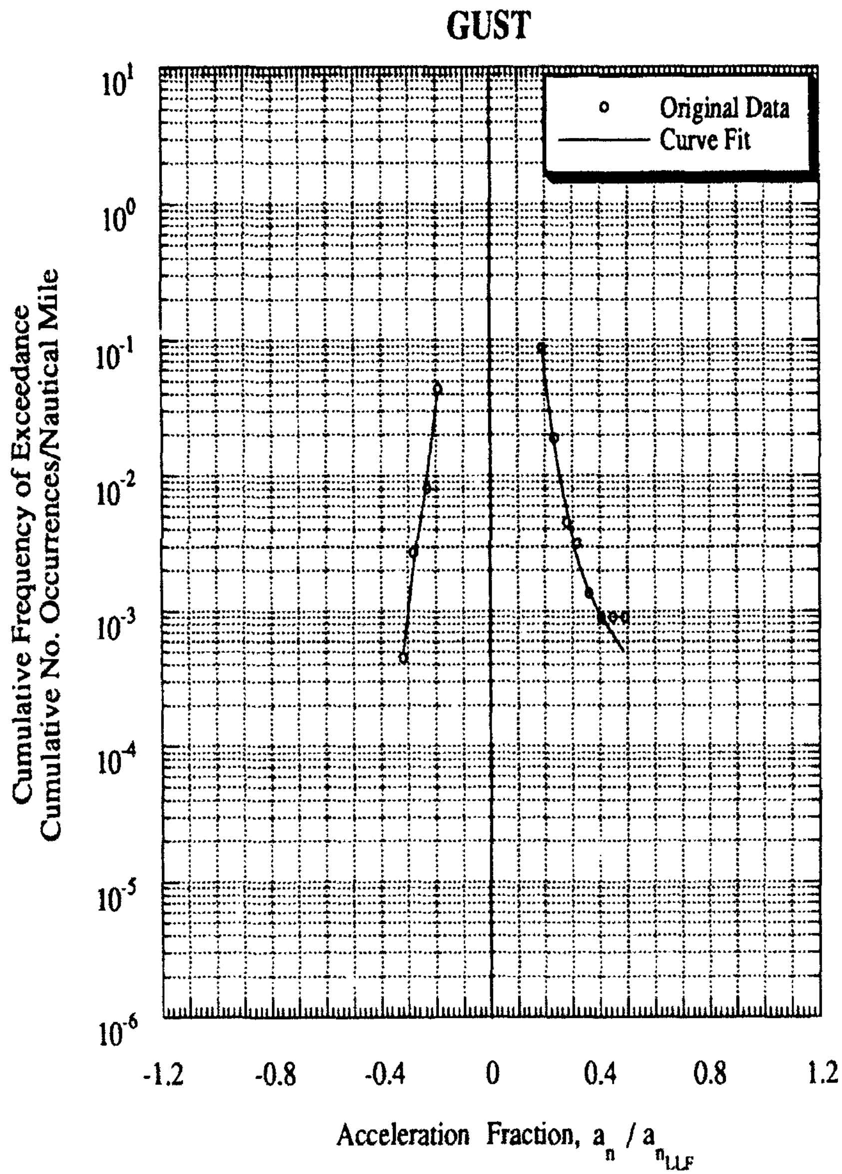
Curve fit for original data ($-0.300 < x < -0.191$)
$\log(y) = -3.092 - 18.326x^2 - 3.299\log(x)$
Curve fit for extrapolation ($-1.200 < x < -0.300$)
$\log(y) = 1.715 - 15.771x$

Curve fit for original data ($0.191 < x < 0.400$)
$\log(y) = -8.187 + 8.793x^2 - 9.446\log(x)$
Curve fit for extrapolation ($0.400 < x < 1.667$)
$\log(y) = -1.733 - 3.221x$

Curve fit for original data ($-0.200 < x < -0.163$)
$\log(y) = -2.254 - 13.856x^2$
Curve fit for extrapolation ($-0.800 < x < -0.200$)
$\log(y) = -2.254 - 13.856x^2$

Curve fit for original data ($0.132 < x < 0.300$)
$\log(y) = -2.983 - 6.778x^2 - 1.747\log(x)$
Curve fit for extrapolation ($0.300 < x < 1.700$)
$\log(y) = -0.700 - 6.597x$

Figure C-13 Load Spectra for Airplane 7A, Single-Engine, Business/Personal



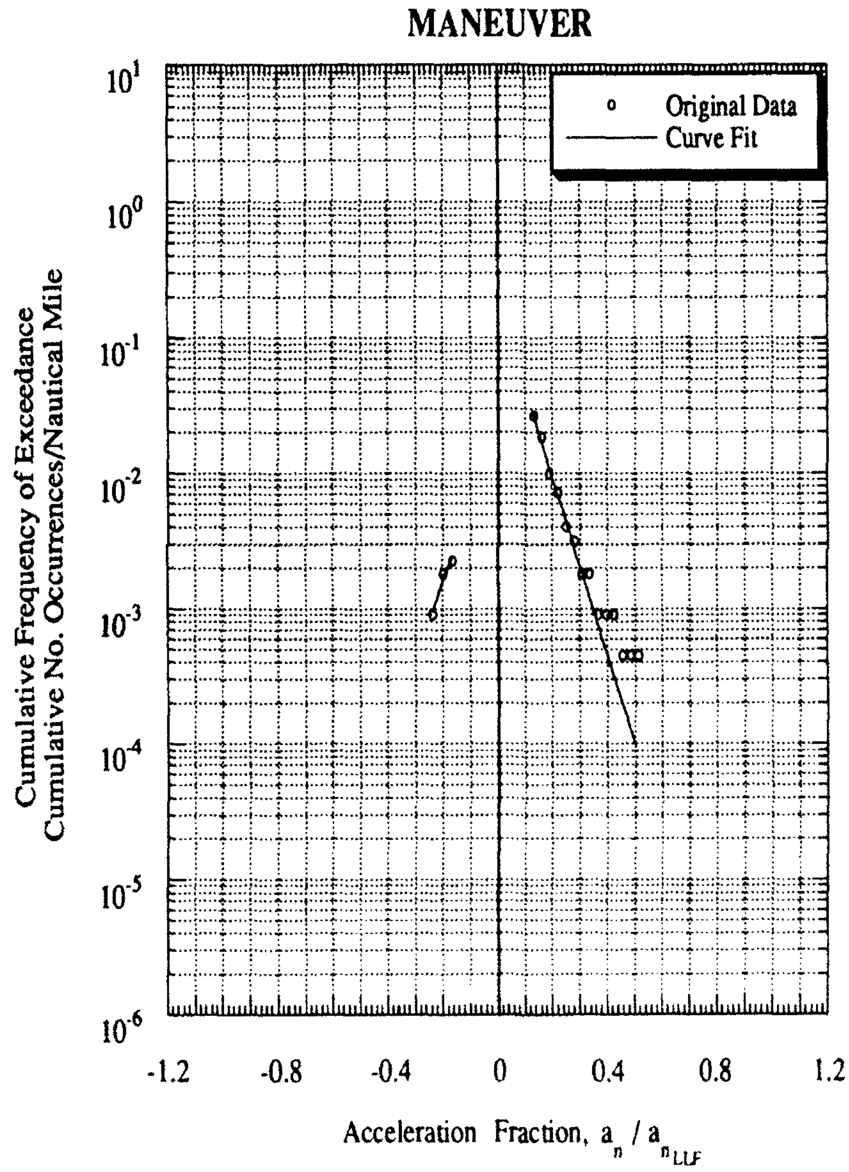


Table C-14 Tabulated Data for Airplane 7B

Total Nautical Miles = 34419 **Total Hours = 229**

GUST negative		GUST positive		MANEUVER negative		MANEUVER positive	
Acceleration Fraction	**Cumulative Frequency of Exceedance**	**Acceleration Fraction**	**Cumulative Frequency of Exceedance**	**Acceleration Fraction**	**Cumulative Frequency of Exceedance**	**Acceleration Fraction**	**Cumulative Frequency of Exceedance**
-0.200	0.0360725	0.200	0.0762953	-0.150	0.0005022	0.150	0.0013281
-0.250	0.0077393	0.250	0.0238968	-0.200	0.0002547	0.200	0.0003129
-0.300	0.0018442	0.300	0.0068432	-0.250	0.0001022	0.250	0.6556E-04
-0.350	0.0004585	0.350	0.0017500	-0.300	0.3657E-04	0.300	0.1272E-04
		0.400	0.0003940	-0.350	0.1309E-04	0.350	0.2468E-05
		0.450	0.7742E-04				

NOTE: for curve fits $x = |x|$

Gust, negative

Curve fit for original data ($-0.350 < x < -0.185$)
$\log(y) = -4.562 - 8.415x^2 - 4.944\log(x)$
Curve fit for extrapolation ($-1.200 < x < -0.350$)
$\log(y) = 0.870 - 12.025x$

Gust, positive

Curve fit for original data ($0.185 < x < 0.450$)
$\log(y) = -1.844 - 14.387x^2 - 1.862\log(x)$
Curve fit for extrapolation ($0.450 < x < 1.667$)
$\log(y) = 2.524 - 14.745x$

Maneuver, negative

Curve fit for original data ($-0.250 < x < -0.163$)
$\log(y) = -2.651 - 18.801x^2 + 0.273\log(x)$
Curve fit for extrapolation ($-0.800 < x < -0.250$)
$\log(y) = -1.759 - 8.926x$

Maneuver, positive

Curve fit for original data ($0.132 < x < 0.250$)
$\log(y) = -4.054 - 21.484x^2 - 2.016\log(x)$
Curve fit for extrapolation ($0.250 < x < 1.700$)
$\log(y) = -0.622 - 14.244x$

Figure C-14 Load Spectra for Airplane 7B, Single-Engine, Business/Personal

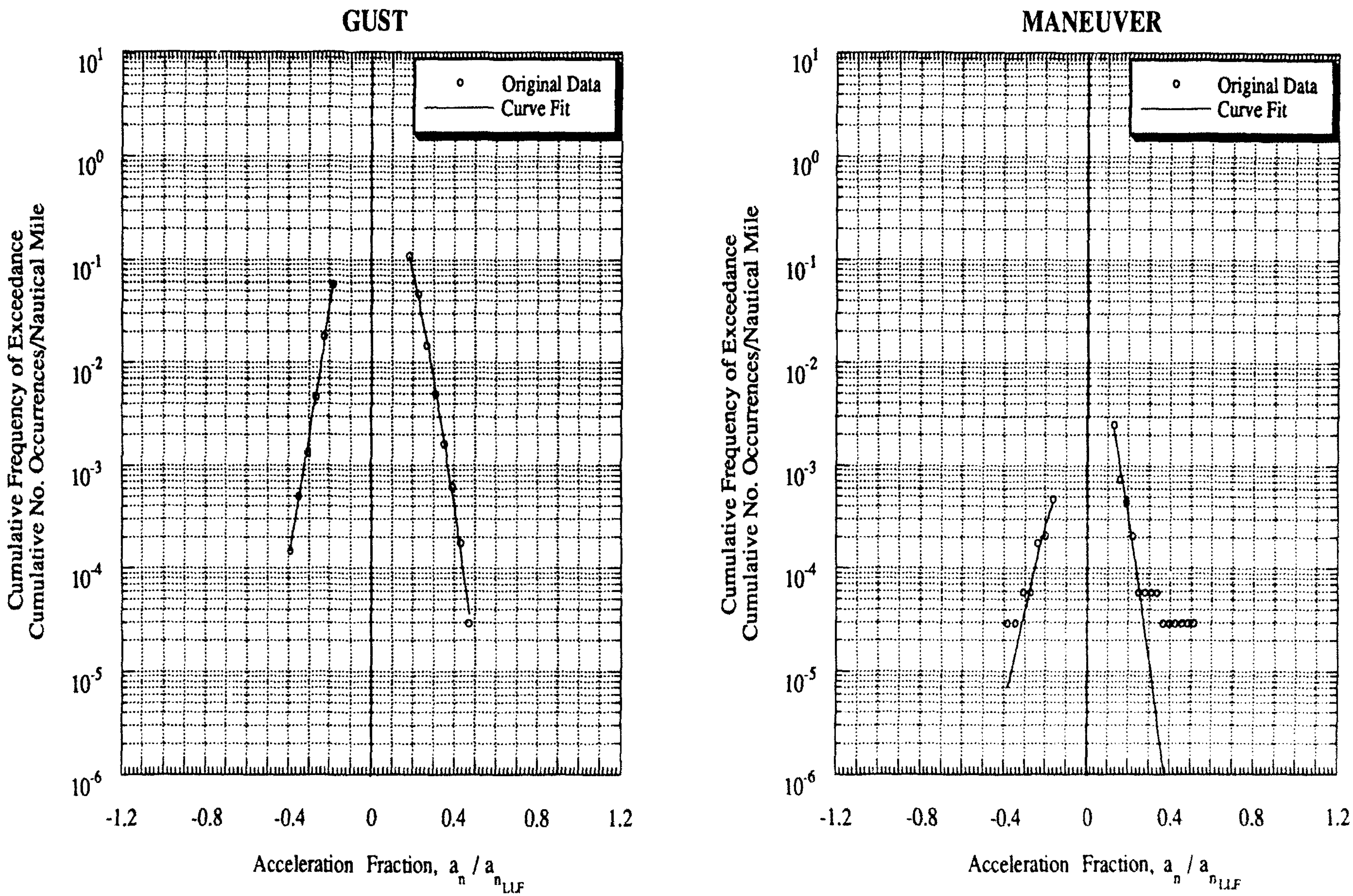


Table C-15 Tabulated Data for Airplane 7C

Total Nautical Miles = 18351 **Total Hours = 150**

GUST negative Acceleration Fraction	GUST negative Cumulative Frequency of Exceedance	GUST positive Acceleration Fraction	GUST positive Cumulative Frequency of Exceedance	MANEUVER negative Acceleration Fraction	MANEUVER negative Cumulative Frequency of Exceedance	MANEUVER positive Acceleration Fraction	MANEUVER positive Cumulative Frequency of Exceedance
-0.200	0.0213617	0.200	0.0361708	-0.150	0.0039952	0.150	0.0032173
-0.250	0.0047190	0.250	0.0074857	-0.200	0.0004370	0.200	0.0014735
-0.300	0.0012053	0.300	0.0019920	-0.250	0.8900E-04	0.250	0.0006368
-0.350	0.0003327	0.350	0.0006265	-0.300	0.2288E-04	0.300	0.0002529
		0.400	0.0002215			0.350	0.9094E-04

NOTE: for curve fits x = |x|

Gust negative

Curve fit for original data (-0.350<x<-0.188)
$\log(y) = -5.136 - 6.248x^2 - 5.316\log(x)$
Curve fit for extrapolation (-1.200<x<-0.350)
$\log(y) = 0.362 - 10.970x$

Gust positive

Curve fit for original data (0.188<x<0.400)
$\log(y) = -6.021 - 1.753x^2 - 6.652\log(x)$
Curve fit for extrapolation (0.400<x<1.667)
$\log(y) = -0.205 - 8.625x$

Maneuver negative

Curve fit for original data (-0.250<x<-0.163)
$\log(y) = -9.577 + 6.096x^2 - 8.546\log(x)$
Curve fit for extrapolation (-0.800<x<-0.250)
$\log(y) = -1.101 - 11.798x$

Maneuver positive

Curve fit for original data (0.132<x<0.350)
$\log(y) = -3.164 - 11.347x^2 - 1.125\log(x)$
Curve fit for extrapolation (0.350<x<1.700)
$\log(y) = -0.773 - 9.339x$

Figure C-15 Load Spectra for Airplane 7C, Single-Engine, Business/Personal

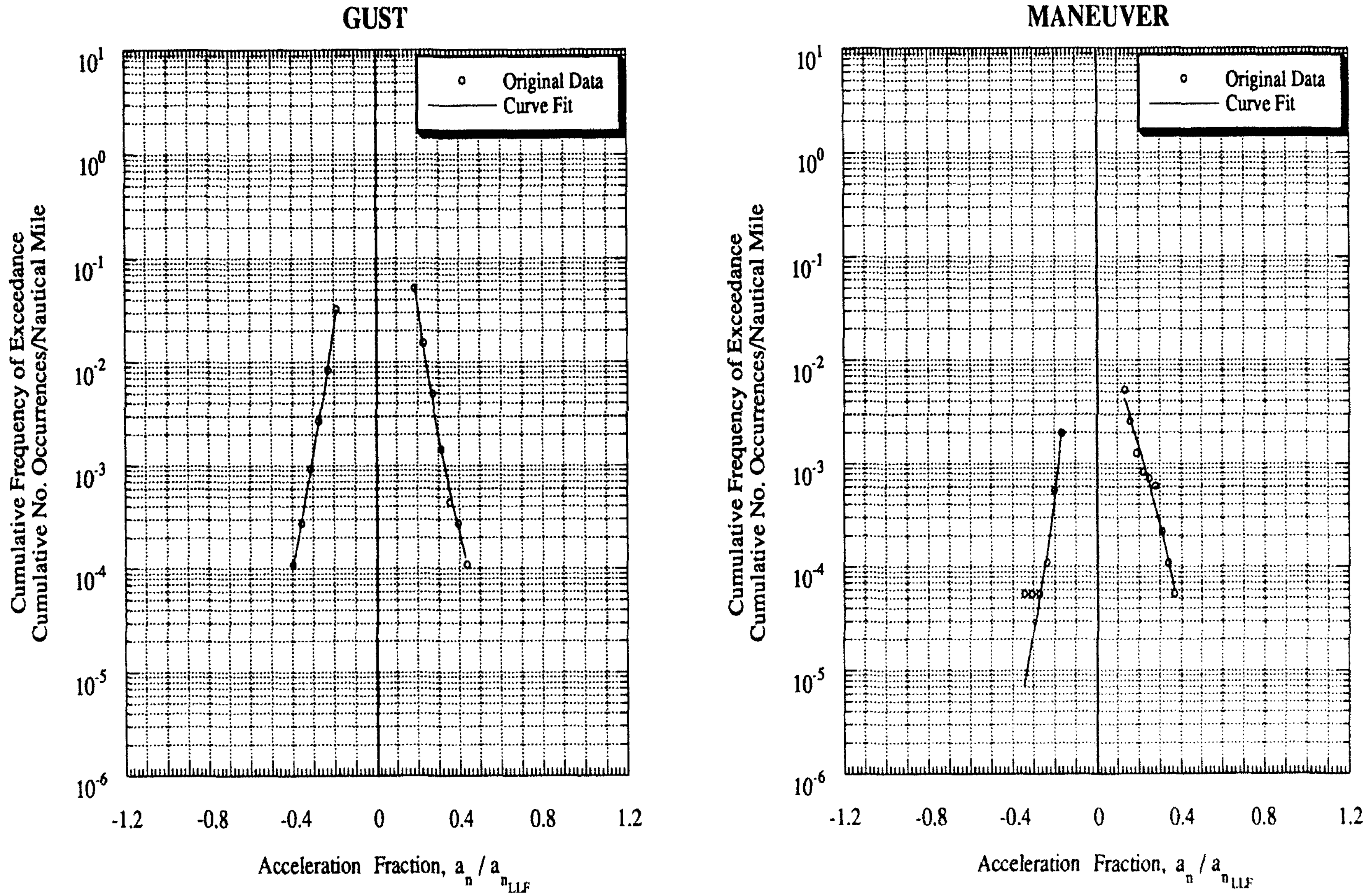


Table C-16 Tabulated Data for Airplane 7C[1]

Total Nautical Miles = 19182 Total Hours = 164

GUST				MANEUVER			
negative		positive		negative		positive	
Acceleration Fraction	Cumulative Frequency of Exceedance	Acceleration Fraction	Cumulative Frequency of Exceedance	Acceleration Fraction	Cumulative Frequency of Exceedance	Acceleration Fraction	Cumulative Frequency of Exceedance
-0.200	0.0438821	0.200	0.0577689	-0.150	0.0141144	0.150	0.0263557
-0.250	0.0155416	0.250	0.0154421	-0.200	0.0065268	0.200	0.0145057
-0.300	0.0058148	0.300	0.0049572	-0.250	0.0027578	0.250	0.0072697
-0.350	0.0022083	0.350	0.0017879	-0.300	0.0010426	0.300	0.0032765
-0.400	0.0008312	0.400	0.0006962	-0.350	0.0003488	0.350	0.0013193
-0.450	0.0003053	0.450	0.0002853	-0.400	0.0001025	0.400	0.0004727
-0.500	0.0001083	0.500	0.0001209			0.450	0.0001596
						0.500	0.5389E-04

NOTE: for curve fits $x = |x|$

Curve fit for original data $(-0.500 < x < -0.188)$
$\log(y) = -3.308 - 6.432x^2 - 3.158\log(x)$
Curve fit for extrapolation $(-1.200 < x < -0.500)$
$\log(y) = 0.622 - 9.175x$

Curve fit for original data $(0.188 < x < 0.500)$
$\log(y) = -4.810 - 2.776x^2 - 5.268\log(x)$
Curve fit for extrapolation $(0.500 < x < 1.667)$
$\log(y) = -0.242 - 7.351x$

Curve fit for original data $(-0.400 < x < -0.163)$
$\log(y) = -2.293 - 12.807x^2 - 0.887\log(x)$
Curve fit for extrapolation $(-0.800 < x < -0.400)$
$\log(y) = 0.494 - 11.209x$

Curve fit for original data $(0.132 < x < 0.400)$
$\log(y) = -1.762 - 11.076x^2 - 0.524\log(x)$
Curve fit for extrapolation $(0.400 < x < 1.700)$
$\log(y) = 0.447 - 9.430x$

Figure C-16 Load Spectra for Airplane 7C[1], Single-Engine, Business/Personal

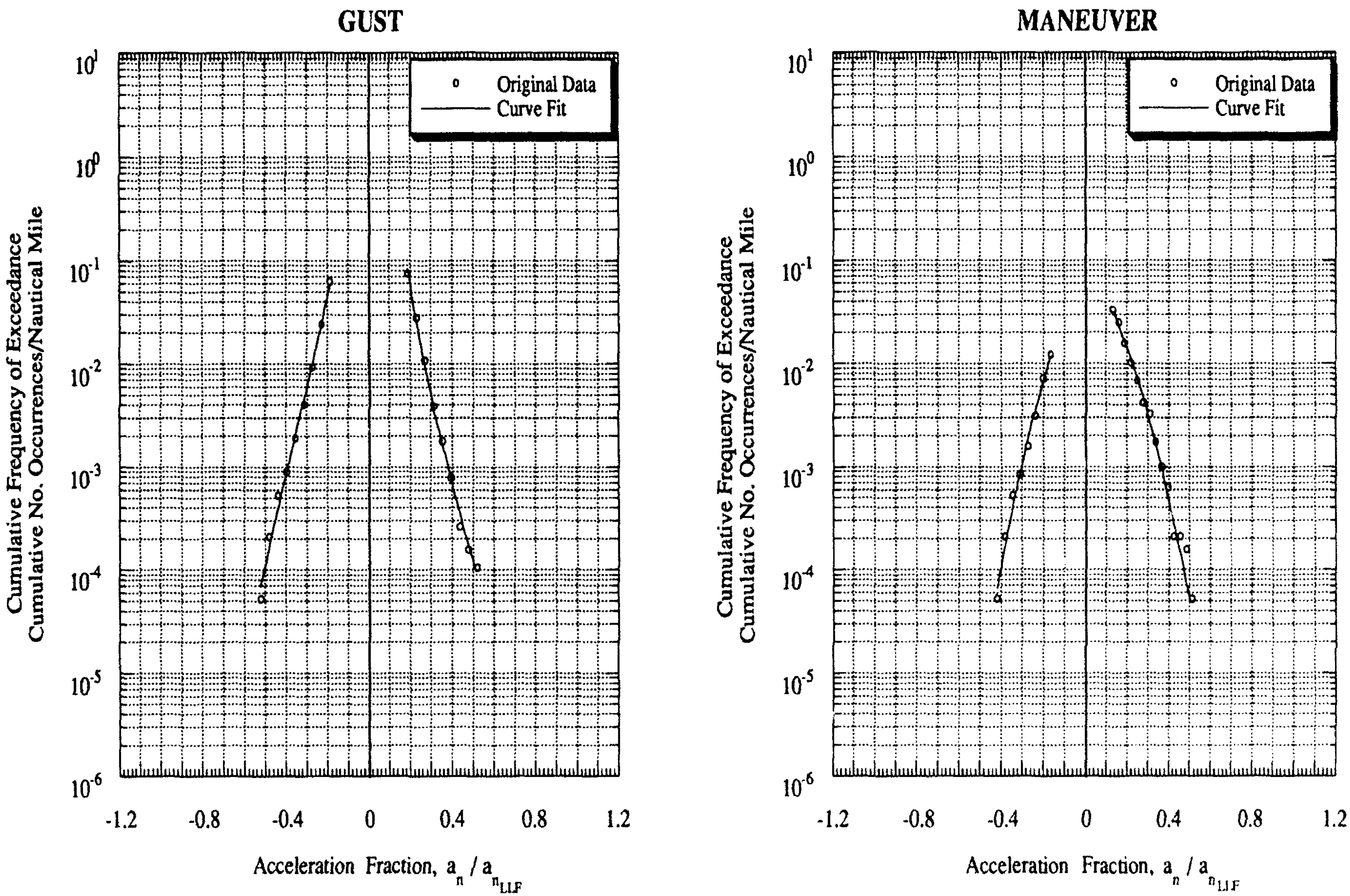


Table C-17 Tabulated Data for Airplane 8

Total Nautical Miles = 38678 Total Hours = 253

GUST				MANEUVER			
negative		positive		negative		positive	
Acceleration Fraction	Cumulative Frequency of Exceedance	Acceleration Fraction	Cumulative Frequency of Exceedance	Acceleration Fraction	Cumulative Frequency of Exceedance	Acceleration Fraction	Cumulative Frequency of Exceedance
-0.200	0.0926825	0.200	0.1292134	-0.200	0.0005849	0.150	0.0067916
-0.250	0.0293778	0.250	0.0362989	-0.250	0.0001356	0.200	0.0021852
-0.300	0.0102698	0.300	0.0123607	-0.300	0.2573E-04	0.250	0.0009157
-0.350	0.0037685	0.350	0.0047743	-0.350	0.4883E-05	0.300	0.0004544
-0.400	0.0014093	0.400	0.0020104			0.350	0.0002538
-0.450	0.0005270	0.450	0.0008997			0.400	0.0001549
-0.500	0.0001945	0.500	0.0004204				
-0.550	0.7022E-04	0.550	0.0002026				
-0.600	0.2500E-04	0.600	0.9981E-04				
-0.650	0.8904E-05	0.650	0.4989E-04				
-0.700	0.3170E-05	0.700	0.2507E-04				
		0.750	0.1260E-04				
		0.800	0.6333E-05				

NOTE: for curve fits $x = |x|$

Curve fit for original data ($-0.550<x<-0.181$)
$\log(y) = -3.550 - 5.349x^2 - 3.907\log(x)$
Curve fit for extrapolation ($-1.200<x<-0.550$)
$\log(y) = 0.779 - 8.969x$

Curve fit for original data ($0.181<x<0.650$)
$\log(y) = -4.482 - 1.899x^2 - 5.249\log(x)$
Curve fit for extrapolation ($0.650<x<1.667$)
$\log(y) = -0.418 - 5.976x$

Curve fit for original data ($-0.250<x<-0.179$)
$\log(y) = -1.420 - 31.599x^2 + 0.785\log(x)$
Curve fit for extrapolation ($-0.800<x<-0.250$)
$\log(y) = -0.259 - 14.435x$

Curve fit for original data ($0.161<x<0.400$)
$\log(y) = -5.481 + 0.476x^2 - 4.008\log(x)$
Curve fit for extrapolation ($0.400<x<1.700$)
$\log(y) = -2.222 - 3.971x$

Figure C-17 Load Spectra for Airplane 8, Single-Engine, Business/Personal

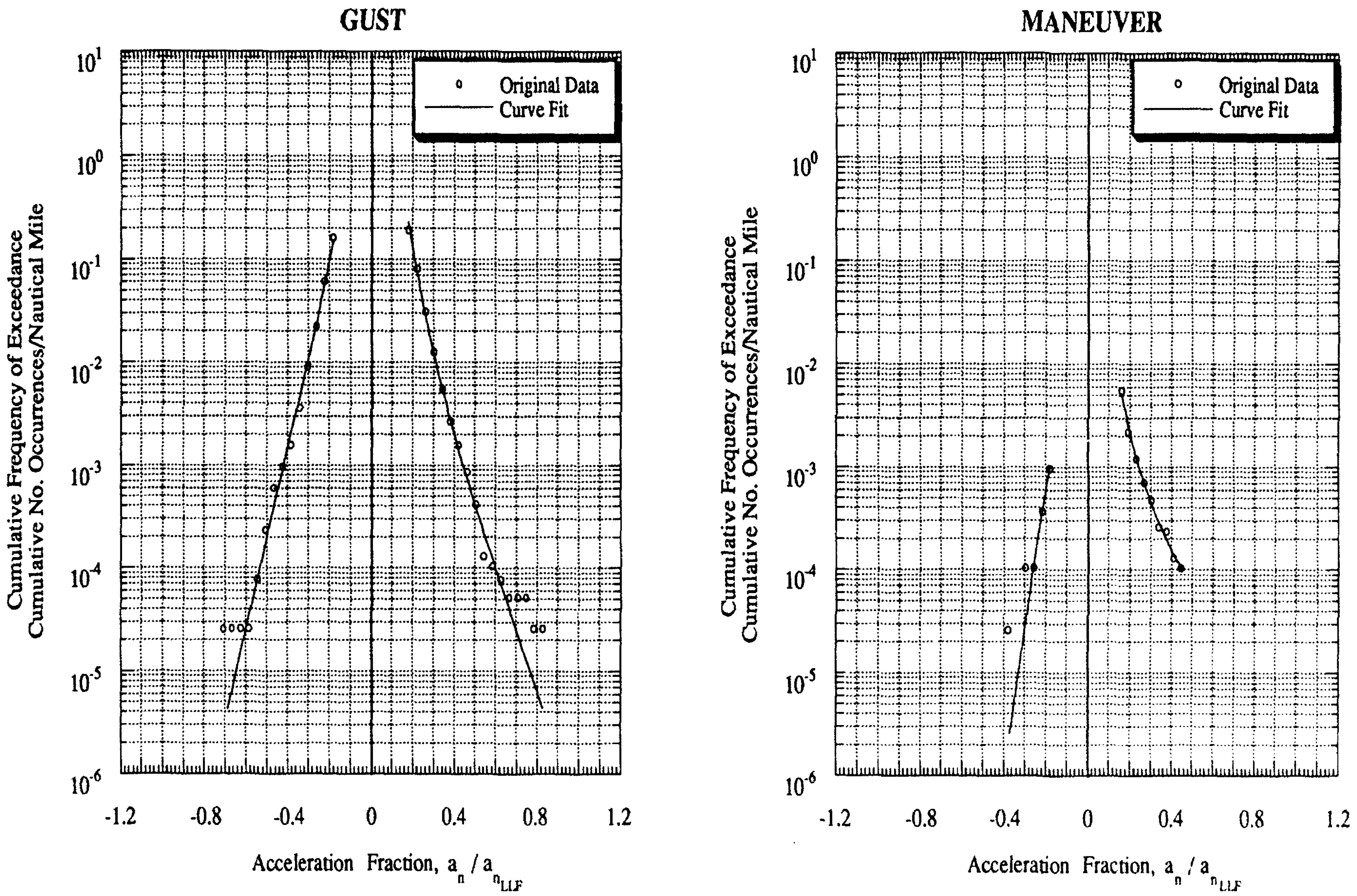


Table C-18 Tabulated Data for Airplane 8A

Total Nautical Miles = 21481 Total Hours = 162

GUST negative		GUST positive		MANEUVER negative		MANEUVER positive	
Acceleration Fraction	Cumulative Frequency of Exceedance	Acceleration Fraction	Cumulative Frequency of Exceedance	Acceleration Fraction	Cumulative Frequency of Exceedance	Acceleration Fraction	Cumulative Frequency of Exceedance
-0.150	0.1953035	0.150	0.1992975	-0.179	0.9311E-04	0.150	0.0025245
-0.200	0.0296518	0.200	0.0265469			0.200	0.0005958
-0.250	0.0062092	0.250	0.0055936			0.250	0.0002681
-0.300	0.0015606	0.300	0.0015773			0.300	0.0001937
-0.350	0.0004371	0.350	0.0005444				
-0.400	0.0001305	0.400	0.0002181				
-0.450	0.3984E-04	0.450	0.9797E-04				
-0.500	0.1216E-04						
-0.550	0.3710E-05						
-0.600	0.1132E-05						

NOTE: for curve fits x = |x|

Curve fit for original data (-0.400<x<-0.170)
$\log(y) = -5.428 - 4.931x^2 - 5.862\log(x)$
Curve fit for extrapolation (-1.200<x<-0.400)
$\log(y) = 0.239 - 10.309x$

Curve fit for original data (0.170<x<0.450)
$\log(y) = -6.517 + 0.309x^2 - 7.051\log(x)$
Curve fit for extrapolation (0.450<x<1.667)
$\log(y) = -1.072 - 6.527x$

Curve fit for original data (0.161<x<0.300)
$\log(y) = -8.887 + 15.624x^2 - 7.207\log(x)$
Curve fit for extrapolation (0.300<x<1.700)
$\log(y) = -3.395 - 1.059x$

Figure C-18 Load Spectra for Airplane 8A, Single-Engine, Business/Personal

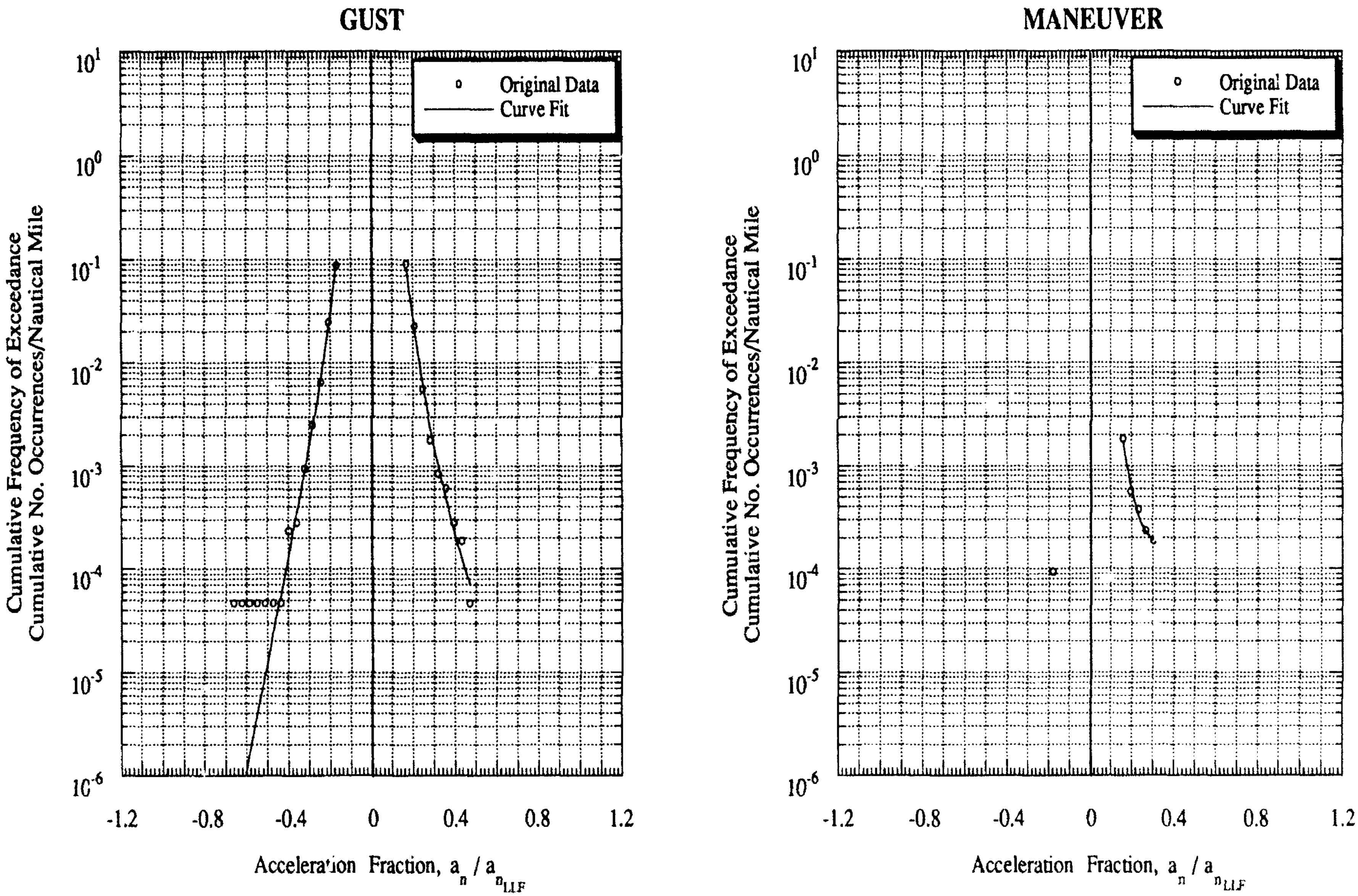


Table C-19 Tabulated Data for Airplane 8A[1]

Total Nautical Miles = 20540 Total Hours = 147

GUST				MANEUVER			
negative		positive		negative		positive	
Acceleration Fraction	Cumulative Frequency of Exceedance	Acceleration Fraction	Cumulative Frequency of Exceedance	Acceleration Fraction	Cumulative Frequency of Exceedance	Acceleration Fraction	Cumulative Frequency of Exceedance
-0.150	0.1398999	0.150	0.2178761	-0.179	0.9737E-04	0.150	0.0008628
-0.200	0.0317764	0.200	0.0374748			0.200	0.8668E-04
-0.250	0.0070583	0.250	0.0080503			0.250	0.2162E-04
-0.300	0.0014369	0.300	0.0019209				
-0.350	0.0002590	0.350	0.0004783				
		0.400	0.0001197				

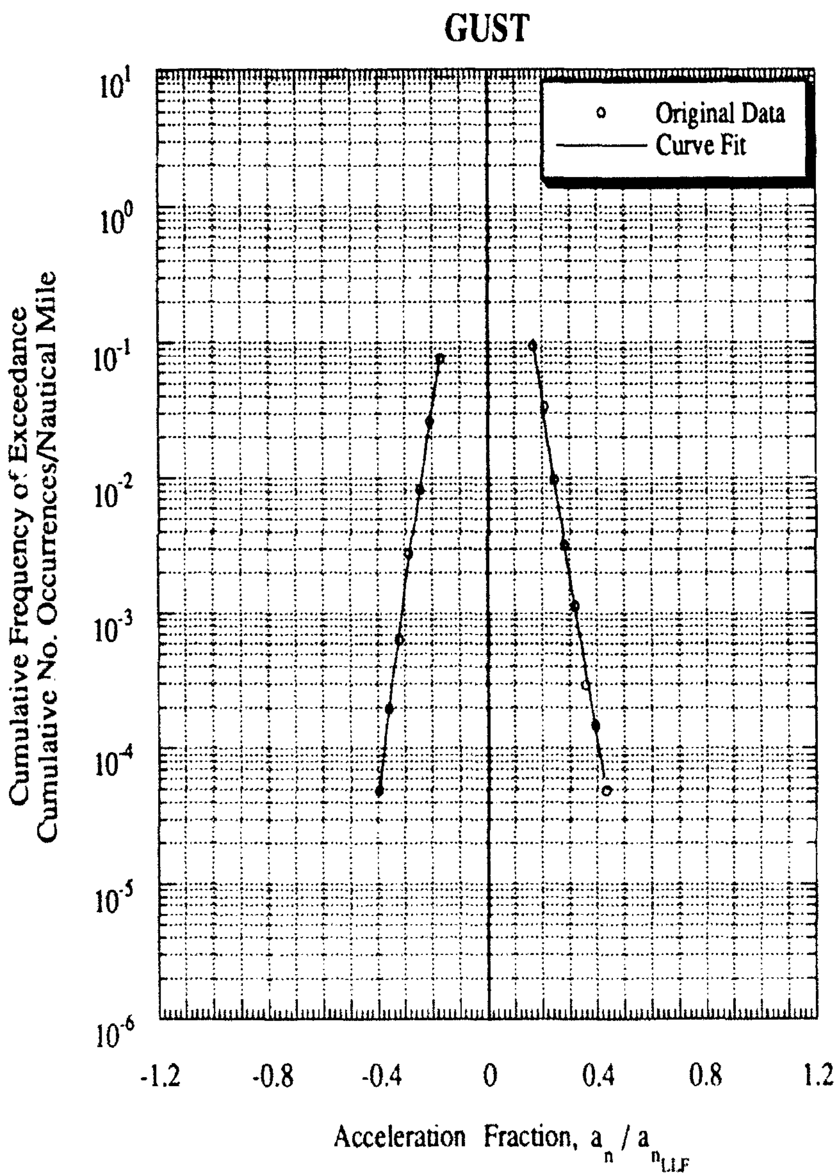
NOTE: for curve fits x = |x|

Curve fit for original data (-0.350<x<-0.170)
$\log(y) = -2.718 - 17.265x^2 - 2.734\log(x)$
Curve fit for extrapolation (-1.200<x<-0.350)
$\log(y) = 1.831 - 15.478x$

Curve fit for original data (0.170<x<0.400)
$\log(y) = -4.545 - 8.398x^2 - 4.942\log(x)$
Curve fit for extrapolation (0.400<x<1.667)
$\log(y) = 0.912 - 12.085x$

Curve fit for original data (0.161<x<0.200)
$\log(y) = -17.249 + 55.138x^2 - 15.711\log(x)$
Curve fit for extrapolation (0.200<x<1.700)
$\log(y) = -1.650 - 12.061x$

Figure C-19 Load Spectra for Airplane 8A[1], Single-Engine, Business/Personal



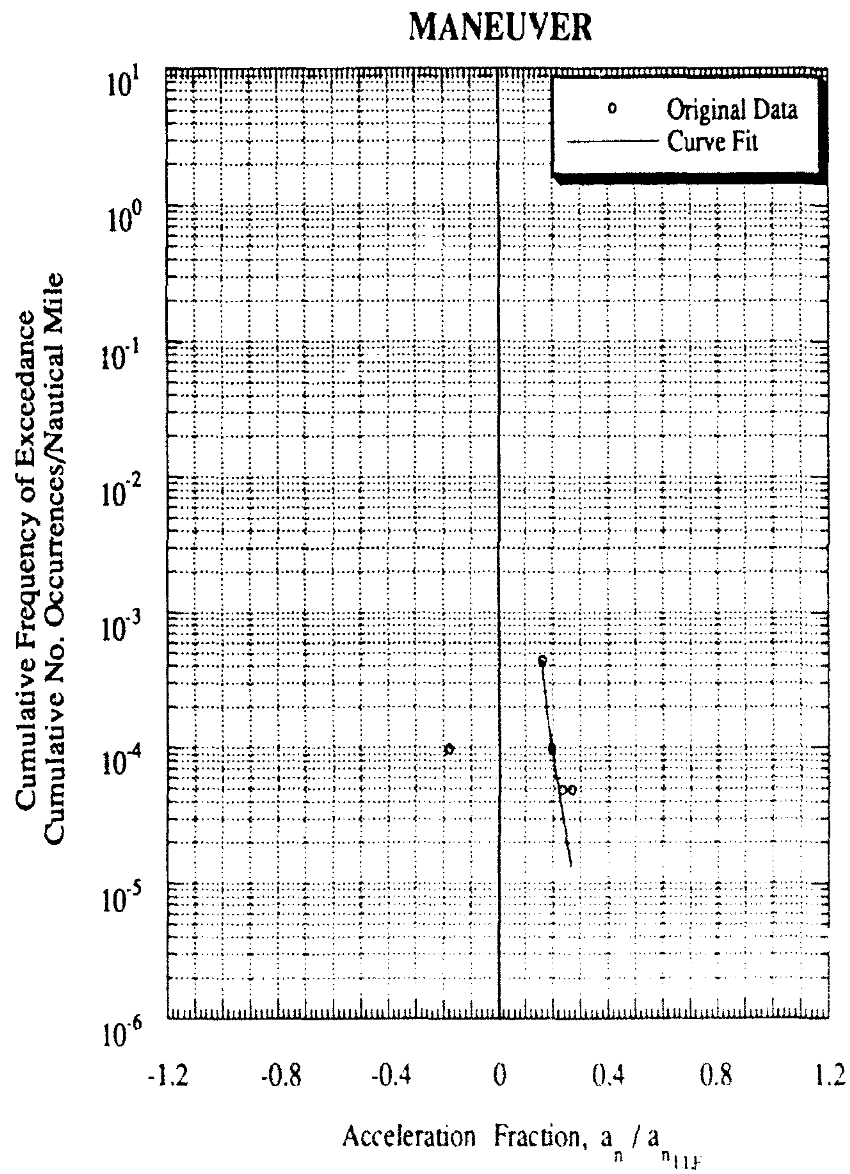


Table C-20 Tabulated Data for Airplane 9

Total Nautical Miles = 37137 Total Hours = 301

GUST negative Acceleration Fraction	GUST negative Cumulative Frequency of Exceedance	GUST positive Acceleration Fraction	GUST positive Cumulative Frequency of Exceedance	MANEUVER negative Acceleration Fraction	MANEUVER negative Cumulative Frequency of Exceedance	MANEUVER positive Acceleration Fraction	MANEUVER positive Cumulative Frequency of Exceedance
-0.200	0.0528739	0.200	0.0703556	-0.200	0.0005387	0.150	0.0038025
-0.250	0.0133240	0.250	0.0157897	-0.250	0.9084E-04	0.200	0.0012651
-0.300	0.0036013	0.300	0.0046880	-0.300	0.1936E-04	0.250	0.0005505
-0.350	0.0009904	0.350	0.0016902			0.300	0.0002851
-0.400	0.0002686	0.400	0.0007031			0.350	0.0001671
-0.450	0.7038E-04	0.450	0.0003266			0.400	0.0001076
		0.500	0.0001656			0.450	0.7465E-04
		0.550	0.9017E-04			0.500	0.5506E-04
		0.600	0.5068E-04				
		0.650	0.2849E-04				

NOTE: for curve fits $x = |x|$

Gust negative

Curve fit for original data $(-0.450 < x < -0.193)$
$\log(y) = -3.839 - 8.675x^2 - 4.163\log(x)$
Curve fit for extrapolation $(-1.200 < x < -0.450)$
$\log(y) = 1.169 - 11.825x$

Gust positive

Curve fit for original data $(0.193 < x < 0.550)$
$\log(y) = -5.896 + 0.309x^2 - 6.768\log(x)$
Curve fit for extrapolation $(0.550 < x < 1.667)$
$\log(y) = -1.293 - 5.004x$

Maneuver negative

Curve fit for original data $(-0.250 < x < -0.179)$
$\log(y) = -9.742 + 4.438x^2 - 9.008\log(x)$
Curve fit for extrapolation $(-0.800 < x < -0.250)$
$\log(y) = -0.684 - 13.429x$

Maneuver positive

Curve fit for original data $(0.161 < x < 0.500)$
$\log(y) = -5.716 + 1.044x^2 - 3.972\log(x)$
Curve fit for extrapolation $(0.500 < x < 1.700)$
$\log(y) = -3.056 - 2.406x$

Figure C-20 Load Spectra for Airplane 9, Single-Engine, Business/Personal

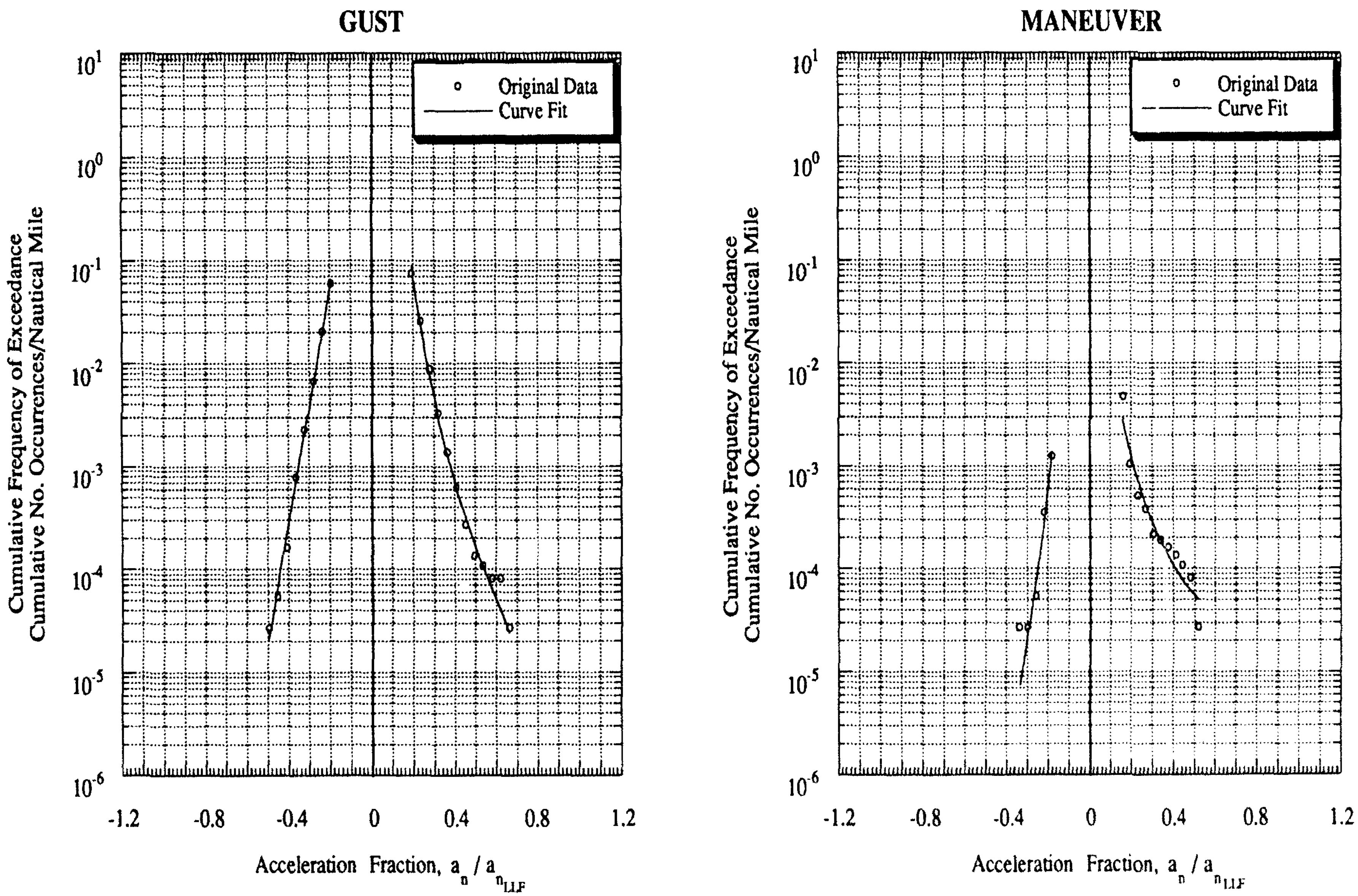


Table C-21 Tabulated Data for Airplane 9A

Total Nautical Miles = 55059 Total Hours = 423

GUST				MANEUVER			
negative		positive		negative		positive	
Acceleration Fraction	Cumulative Frequency of Exceedance	Acceleration Fraction	Cumulative Frequency of Exceedance	Acceleration Fraction	Cumulative Frequency of Exceedance	Acceleration Fraction	Cumulative Frequency of Exceedance
-0.200	0.0530022	0.200	0.0730688	-0.200	0.0029559	0.150	0.0097858
-0.250	0.0138110	0.250	0.0184783	-0.250	0.0017334	0.200	0.0039883
-0.300	0.0044752	0.300	0.0055256	-0.300	0.0008751	0.250	0.0018977
-0.350	0.0016775	0.350	0.0018286	-0.350	0.0003821	0.300	0.0009863
-0.400	0.0006966	0.400	0.0006438	-0.400	0.0001446	0.350	0.0005405
-0.450	0.0003117	0.450	0.0002350			0.400	0.0003057
-0.500	0.0001474	0.500	0.8746E-04			0.450	0.0001761
-0.550	0.7275E-04	0.550	0.3276E-04			0.500	0.0001023
-0.600	0.3706E-04	0.600	0.1227E-04				
-0.650	0.1913E-04						

NOTE: for curve fits $x = |x|$

Curve fit for original data (-0.600<x<-0.180)
$\log(y) = -5.218 - 1.337x^2 - 5.716\log(x)$
Curve fit for extrapolation (-1.200<x<-0.600)
$\log(y) = -0.986 - 5.743x$

Curve fit for original data (0.180<x<0.550)
$\log(y) = -4.634 - 3.998x^2 - 5.233\log(x)$
Curve fit for extrapolation (0.550<x<1.667)
$\log(y) = 0.207 - 8.530x$

Curve fit for original data (-0.400<x<-0.179)
$\log(y) = -1.818 - 11.784x^2 + 0.344\log(x)$
Curve fit for extrapolation (-0.800<x<-0.400)
$\log(y) = -0.218 - 9.054x$

Curve fit for original data (0.161<x<0.500)
$\log(y) = -4.268 - 2.264x^2 - 2.803\log(x)$
Curve fit for extrapolation (0.500<x<1.700)
$\log(y) = -1.641 - 4.699x$

Figure C-21 Load Spectra for Airplane 9A, Single-Engine, Business/Personal

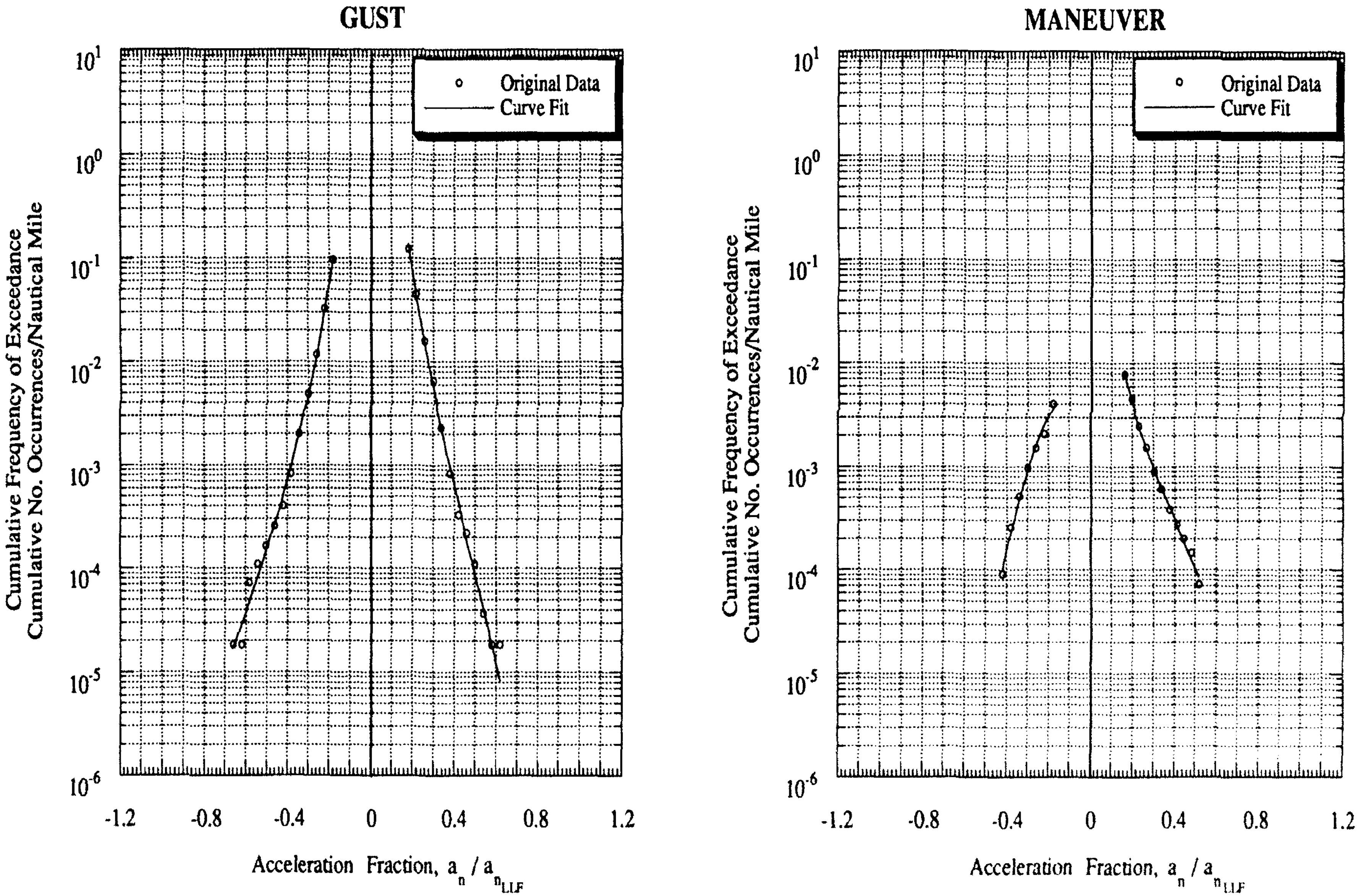


Table C-22 Tabulated Data for Airplane 10

Total Nautical Miles = 31563 **Total Hours = 225**

GUST				MANEUVER			
negative		positive		negative		positive	
Acceleration Fraction	Cumulative Frequency of Exceedance	Acceleration Fraction	Cumulative Frequency of Exceedance	Acceleration Fraction	Cumulative Frequency of Exceedance	Acceleration Fraction	Cumulative Frequency of Exceedance
-0.200	0.0503258	0.200	0.0551744	-0.200	0.0002245	0.150	0.0051248
-0.250	0.0147547	0.250	0.0162657			0.200	0.0008378
-0.300	0.0043805	0.300	0.0053053			0.250	0.0001768
-0.350	0.0012654	0.350	0.0018172			0.300	0.4247E-04
-0.400	0.0003473	0.400	0.0006337				
-0.450	0.8919E-04	0.450	0.0002205				
		0.500	0.7550E-04				

NOTE: for curve fits x = |x|

Curve fit for original data ($-0.450 < x < -0.190$)
$\log(y) = -3.099 - 10.095x^2 - 3.155\log(x)$
Curve fit for extrapolation ($-1.200 < x < -0.450$)
$\log(y) = 1.409 - 12.130x$

Curve fit for original data ($0.190 < x < 0.500$)
$\log(y) = -3.905 - 5.829x^2 - 4.120\log(x)$
Curve fit for extrapolation ($0.500 < x < 1.667$)
$\log(y) = 0.582 - 9.408x$

Curve fit for original data ($-0.200 < x < -0.179$)
$\log(y) = 2.455 - 30.521x$
Curve fit for extrapolation ($-0.800 < x < -0.200$)
$\log(y) = 2.455 - 30.521x$

Curve fit for original data ($0.161 < x < 0.300$)
$\log(y) = -6.462 - 7.364x^2 - 5.264\log(x)$
Curve fit for extrapolation ($0.300 < x < 1.700$)
$\log(y) = -0.760 - 12.038x$

Figure C-22 Load Spectra for Airplane 10, Single-Engine, Business/Personal

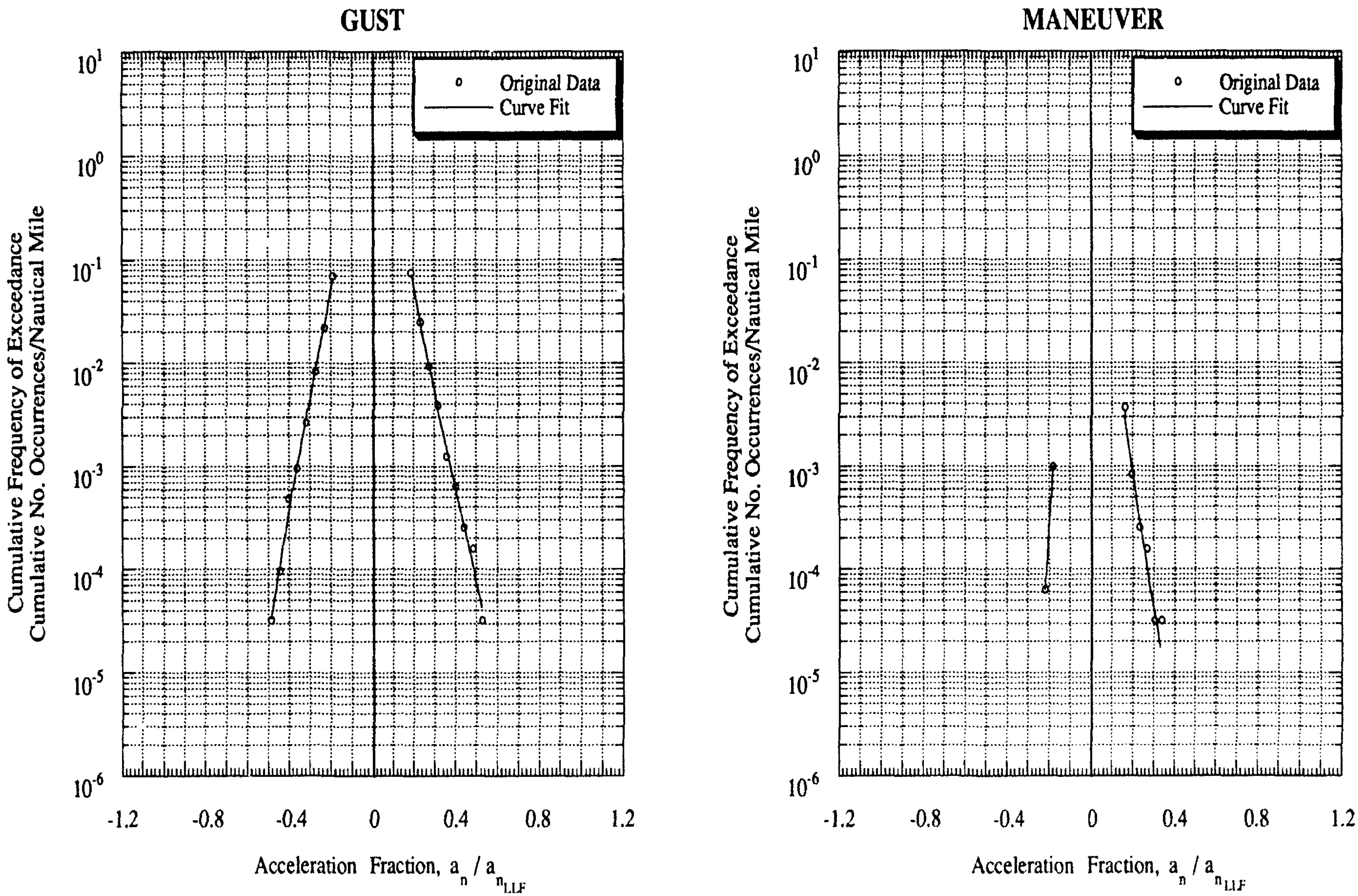


Table C-23 Tabulated Data for Airplane 10[1]

Total Nautical Miles = 22436 Total Hours = 175

GUST negative: Acceleration Fraction	GUST negative: Cumulative Frequency of Exceedance	GUST positive: Acceleration Fraction	GUST positive: Cumulative Frequency of Exceedance	MANEUVER negative: Acceleration Fraction	MANEUVER negative: Cumulative Frequency of Exceedance	MANEUVER positive: Acceleration Fraction	MANEUVER positive: Cumulative Frequency of Exceedance
-0.200	0.0246637	0.200	0.0253471	-0.200	0.0015795	0.150	0.0195901
-0.250	0.0061691	0.250	0.0062819	-0.250	0.0003247	0.200	0.0123401
-0.300	0.0018091	0.300	0.0019617	-0.300	0.9275E-04	0.250	0.0071103
-0.350	0.0005826	0.350	0.0007156	-0.350	0.3014E-04	0.300	0.0037216
		0.400	0.0002914	-0.400	0.9795E-05	0.350	0.0017630
		0.450	0.0001287	-0.450	0.3183E-05	0.400	0.0007542
		0.500	0.5878E-04			0.450	0.0002909
		0.550	0.2684E-04			0.500	0.0001011

NOTE: for curve fits $x = |x|$

GUST negative

Curve fit for original data ($-0.350 < x < -0.190$)
$\log(y) = -5.038 - 4.500x^2 - 5.165\log(x)$
Curve fit for extrapolation ($-1.200 < x < -0.350$)
$\log(y) = 0.111 - 9.560x$

GUST positive

Curve fit for original data ($0.190 < x < 0.450$)
$\log(y) = -5.734 - 1.147x^2 - 5.985\log(x)$
Curve fit for extrapolation ($0.450 < x < 1.667$)
$\log(y) = -0.826 - 6.809x$

MANEUVER negative

Curve fit for original data ($-0.300 < x < -0.179$)
$\log(y) = -8.141 + 1.898x^2 - 7.531\log(x)$
Curve fit for extrapolation ($-0.800 < x < -0.300$)
$\log(y) = -1.104 - 9.763x$

MANEUVER positive

Curve fit for original data ($0.161 < x < 0.500$)
$\log(y) = -1.738 - 9.382x^2 - 0.292\log(x)$
Curve fit for extrapolation ($0.500 < x < 1.700$)
$\log(y) = 0.823 - 9.636x$

Figure C-23 Load Spectra for Airplane 10^1, Single-Engine, Business/Personal

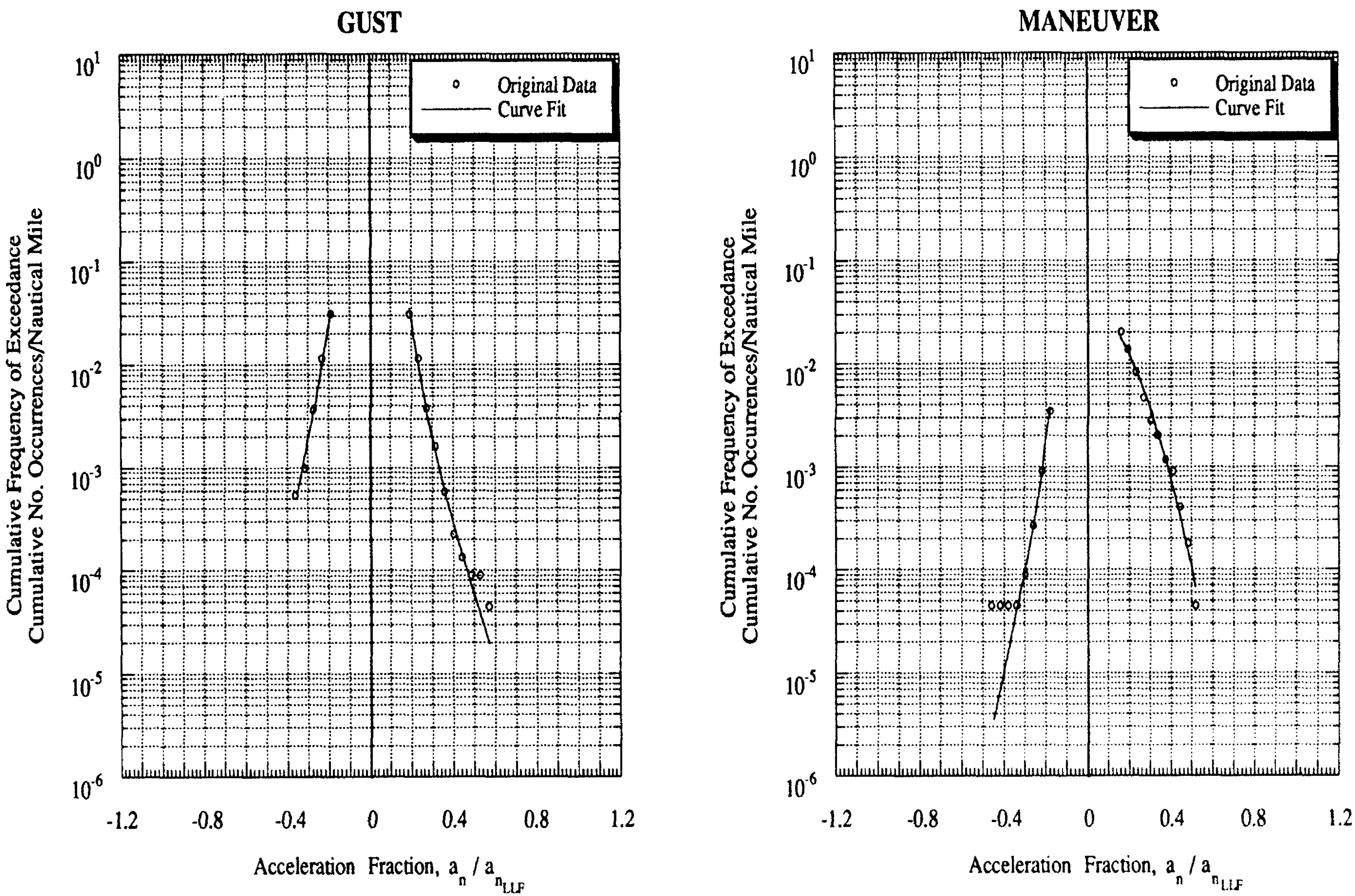


Table C-24 Tabulated Data for Airplane 10A

Total Nautical Miles = 34231 Total Hours = 265

GUST				MANEUVER			
negative		positive		negative		positive	
Acceleration Fraction	Cumulative Frequency of Exceedance	Acceleration Fraction	Cumulative Frequency of Exceedance	Acceleration Fraction	Cumulative Frequency of Exceedance	Acceleration Fraction	Cumulative Frequency of Exceedance
-0.200	0.0172749	0.200	0.0267541	-0.200	0.0001044	0.150	0.0038008
-0.250	0.0034826	0.250	0.0073910	-0.250	0.3159E-04	0.200	0.0007647
-0.300	0.0009715	0.300	0.0021597	-0.300	0.1771E-04	0.250	0.0002543
-0.350	0.0003409	0.350	0.0006363			0.300	0.0001196
-0.400	0.0001422					0.350	0.6490E-04
-0.450	0.6792E-04					0.400	0.3521E-04
-0.500	0.3626E-04					0.450	0.1910E-04
						0.500	0.1036E-04
						0.550	0.5623E-05
						0.600	0.3050E-05
						0.650	0.1655E-05

NOTE: for curve fits $x = |x|$

Curve fit for original data ($-0.500<x<-0.186$)
$\log(y) = -7.085 + 1.513x^2 - 7.528\log(x)$
Curve fit for extrapolation ($-1.200<x<-0.500$)
$\log(y) = -1.928 - 5.026x$

Curve fit for original data ($0.186<x<0.350$)
$\log(y) = -3.875 - 8.539x^2 - 3.783\log(x)$
Curve fit for extrapolation ($0.350<x<1.667$)
$\log(y) = 0.538 - 10.671x$

Curve fit for original data ($-0.250<x<-0.179$)
$\log(y) = -16.683 + 44.279x^2 - 15.639\log(x)$
Curve fit for extrapolation ($-0.800<x<-0.250$)
$\log(y) = -3.244 - 5.028x$

Curve fit for original data ($0.161<x<0.300$)
$\log(y) = -7.970 + 6.941x^2 - 6.546\log(x)$
Curve fit for extrapolation ($0.300<x<1.700$)
$\log(y) = -2.329 - 5.312x$

Figure C-24 Load Spectra for Airplane 10A, Single-Engine, Business/Personal

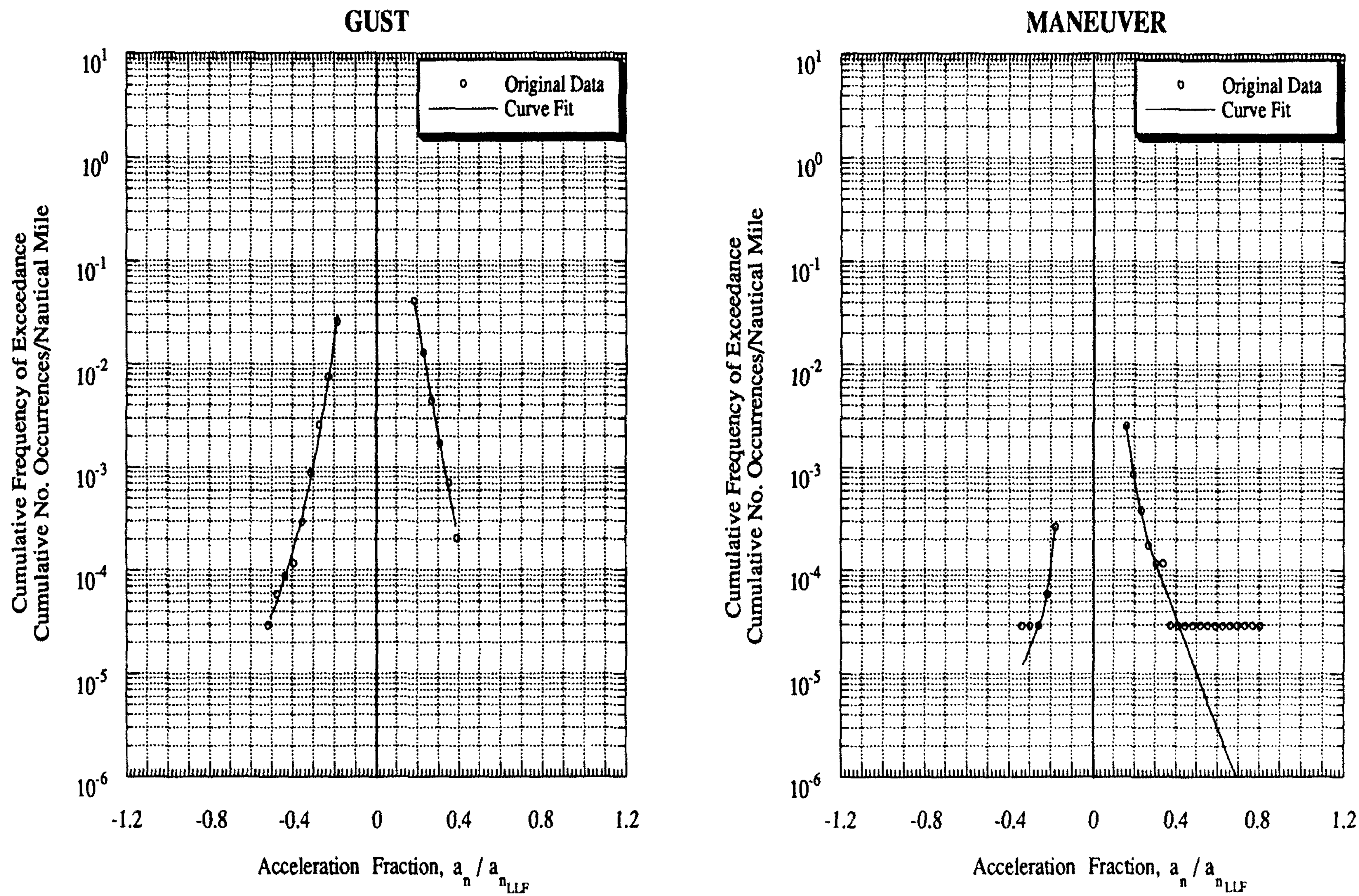


Table C-25 Tabulated Data for Airplane 11

Total Nautical Miles = 12596 Total Hours = 131

GUST				MANEUVER			
negative		positive		negative		positive	
Acceleration Fraction	Cumulative Frequency of Exceedance	Acceleration Fraction	Cumulative Frequency of Exceedance	Acceleration Fraction	Cumulative Frequency of Exceedance	Acceleration Fraction	Cumulative Frequency of Exceedance
-0.200	0.0273982	0.200	0.0212591	-0.200	0.0052085	0.150	0.0522329
-0.250	0.0088862	0.250	0.0059083	-0.250	0.0016747	0.200	0.0203248
-0.300	0.0027082	0.300	0.0015034	-0.300	0.0005728	0.250	0.0087593
-0.350	0.0007554	0.350	0.0003408	-0.350	0.0001988	0.300	0.0039370
				-0.400	0.6897E-04	0.350	0.0017874
						0.400	0.0008040
						0.450	0.0003540
						0.500	0.0001513
						0.550	0.6354E-04

NOTE: for curve fits $x = |x|$

Curve fit for original data $(-0.350 < x < -0.187)$
$\log(y) = -2.504 - 12.778x^2 - 2.079\log(x)$
Curve fit for extrapolation $(-1.200 < x < -0.350)$
$\log(y) = 0.912 - 11.525x$

Curve fit for original data $(0.187 < x < 0.350)$
$\log(y) = -2.576 - 15.361x^2 - 2.172\log(x)$
Curve fit for extrapolation $(0.350 < x < 1.667)$
$\log(y) = 1.239 - 13.447x$

Curve fit for original data $(-0.300 < x < -0.179)$
$\log(y) = -4.433 - 6.944x^2 - 3.473\log(x)$
Curve fit for extrapolation $(-0.800 < x < -0.300)$
$\log(y) = -0.484 - 9.193x$

Curve fit for original data $(0.161 < x < 0.500)$
$\log(y) = -3.250 - 5.333x^2 - 2.534\log(x)$
Curve fit for extrapolation $(0.500 < x < 1.700)$
$\log(y) = -0.053 - 7.534x$

Figure C-25 Load Spectra for Airplane 11, Single-Engine, Business/Personal

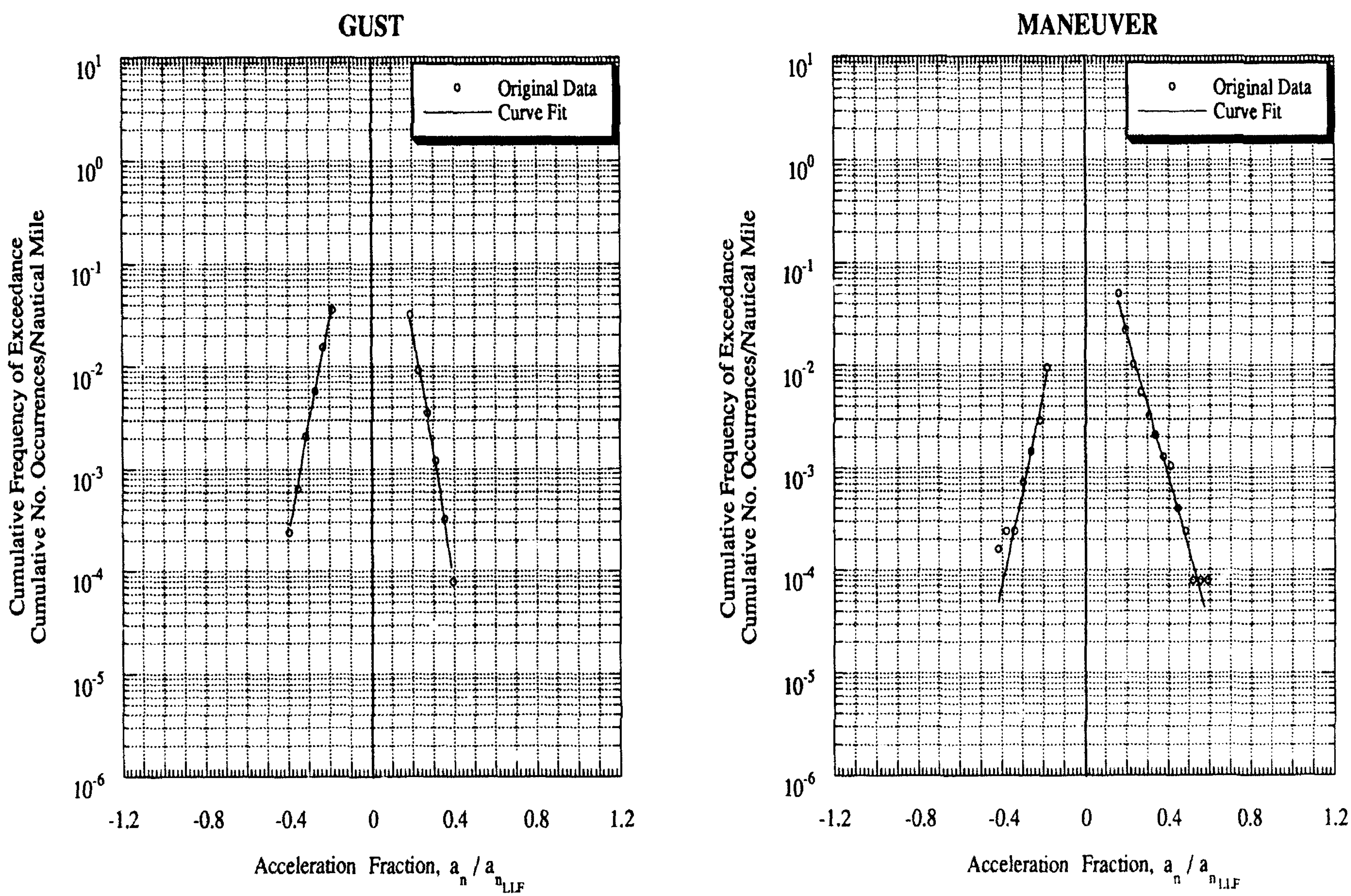


Table C-26 Tabulated Data for Airplane 12

Total Nautical Miles = 3101 Total Hours = 30

GUST				MANEUVER			
negative		positive		negative		positive	
Acceleration Fraction	Cumulative Frequency of Exceedance	Acceleration Fraction	Cumulative Frequency of Exceedance	Acceleration Fraction	Cumulative Frequency of Exceedance	Acceleration Fraction	Cumulative Frequency of Exceedance
-0.200	0.0264372	0.200	0.0237631	-0.200	0.0015365	0.150	0.0099943
-0.250	0.0052651	0.250	0.0041013	-0.250	0.0004051	0.200	0.0044496
		0.300	0.0011207			0.250	0.0018462
		0.350	0.0004305			0.300	0.0006955
		0.400	0.0001910			0.350	0.0002484

NOTE: for curve fits $x = |x|$

Gust, negative

Curve fit for original data $(-0.250 < x < -0.196)$
$\log(y) = -4.829 - 8.915x^2 - 5.162\log(x)$
Curve fit for extrapolation $(-1.200 < x < -0.250)$
$\log(y) = 1.077 - 13.424x$

Gust, positive

Curve fit for original data $(0.196 < x < 0.350)$
$\log(y) = -8.458 + 6.579x^2 - 9.400\log(x)$
Curve fit for extrapolation $(0.350 < x < 1.667)$
$\log(y) = -0.895 - 7.059x$

Maneuver, negative

Curve fit for original data $(-0.250 < x < -0.179)$
$\log(y) = -3.053 - 19.459x^2 - 1.457\log(x)$
Curve fit for extrapolation $(-0.800 < x < -0.250)$
$\log(y) = -0.327 - 12.260x$

Maneuver, positive

Curve fit for original data $(0.161 < x < 0.300)$
$\log(y) = -2.627 - 12.264x^2 - 1.095\log(x)$
Curve fit for extrapolation $(0.300 < x < 1.700)$
$\log(y) = -0.475 - 8.943x$

Figure C-26 Load Spectra for Airplane 12, Single-Engine, Business/Personal

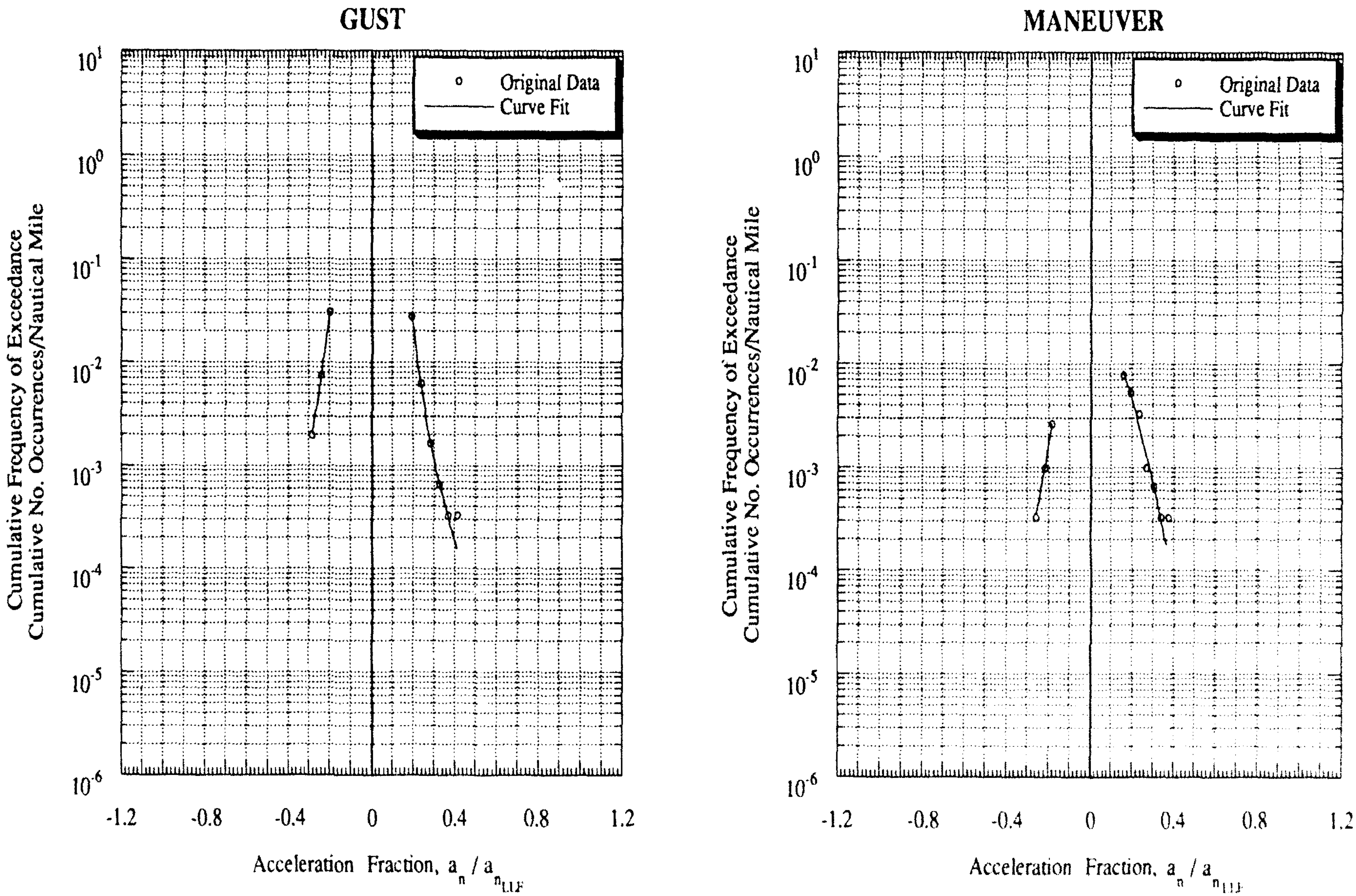


Table C-27 Tabulated Data for Airplane 12[1]

Total Nautical Miles = 16836 **Total Hours = 199**

GUST				MANEUVER			
negative		positive		negative		positive	
Acceleration Fraction	Cumulative Frequency of Exceedance	Acceleration Fraction	Cumulative Frequency of Exceedance	Acceleration Fraction	Cumulative Frequency of Exceedance	Acceleration Fraction	Cumulative Frequency of Exceedance
-0.200	0.0229331	0.200	0.0202239	-0.200	0.0070208	0.150	0.0475123
-0.250	0.0045752	0.250	0.0048128	-0.250	0.0031913	0.200	0.0216849
-0.300	0.0012251	0.300	0.0014362	-0.300	0.0015585	0.250	0.0107341
-0.350	0.0004019	0.350	0.0004979	-0.350	0.0007900	0.300	0.0054853
-0.400	0.0001529	0.400	0.0001916	-0.400	0.0004072	0.350	0.0028186
-0.450	0.6188E-04	0.450	0.7950E-04	-0.450	0.0002105	0.400	0.0014336
-0.500	0.2504E-04			-0.500	0.0001082	0.450	0.0007145
-0.550	0.1013E-04					0.500	0.0003465
						0.550	0.0001627
						0.600	0.7511E-04
						0.650	0.3467E-04
						0.700	0.1600E-04

NOTE: for curve fits $x = |x|$

Curve fit for original data ($-0.400 < x < -0.196$)
$\log(y) = -6.683 - 0.029x^2 - 7.217\log(x)$
Curve fit for extrapolation ($-1.200 < x < -0.400$)
$\log(y) = -0.672 - 7.859x$

Curve fit for original data ($0.196 < x < 0.450$)
$\log(y) = -5.841 - 1.731x^2 - 6.032\log(x)$
Curve fit for extrapolation ($0.450 < x < 1.667$)
$\log(y) = -0.779 - 7.379x$

Curve fit for original data ($-0.500 < x < -0.179$)
$\log(y) = -3.925 - 3.452x^2 - 2.732\log(x)$
Curve fit for extrapolation ($-0.800 < x < -0.500$)
$\log(y) = -1.053 - 5.825x$

Curve fit for original data ($0.161 < x < 0.550$)
$\log(y) = -2.934 - 4.612x^2 - 2.081\log(x)$
Curve fit for extrapolation ($0.550 < x < 1.700$)
$\log(y) = -0.095 - 6.716x$

Figure C-27 Load Spectra for Airplane 12[1], Single-Engine, Business/Personal

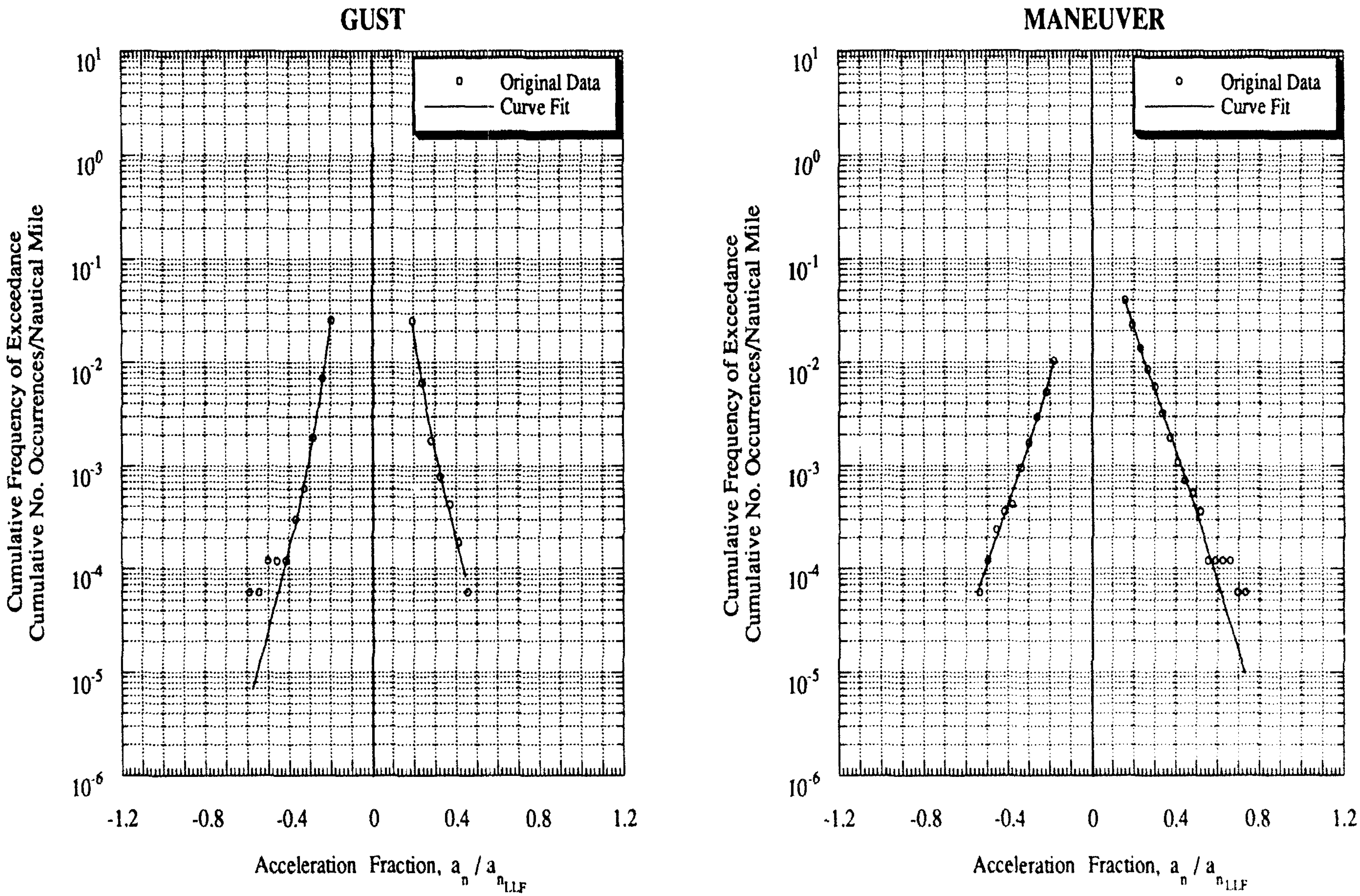


Table C-28 Tabulated Data for Airplane 12[2]

Total Nautical Miles = 8222 Total Hours = 81

GUST negative: Acceleration Fraction	GUST negative: Cumulative Frequency of Exceedance	GUST positive: Acceleration Fraction	GUST positive: Cumulative Frequency of Exceedance	MANEUVER negative: Acceleration Fraction	MANEUVER negative: Cumulative Frequency of Exceedance	MANEUVER positive: Acceleration Fraction	MANEUVER positive: Cumulative Frequency of Exceedance
-0.200	0.0201958	0.200	0.0313561	-0.200	0.0011173	0.150	0.0211008
-0.250	0.0045416	0.250	0.0027356	-0.250	0.0001725	0.200	0.0079563
-0.300	0.0010611	0.300	0.0006804			0.250	0.0030552
-0.350	0.0002446					0.300	0.0011388
						0.350	0.0004016

NOTE: for curve fits $x = |x|$

Curve fit for original data $(-0.350<x<-0.196)$
$\log(y) = -4.106 - 11.185x^2 - 4.090\log(x)$
Curve fit for extrapolation $(-1.200<x<-0.350)$
$\log(y) = 0.905 - 12.905x$

Curve fit for original data $(0.196<x<0.300)$
$\log(y) = -14.939 + 28.651x^2 - 17.583\log(x)$
Curve fit for extrapolation $(0.300<x<1.667)$
$\log(y) = -0.688 - 8.263x$

Curve fit for original data $(-0.250<x<-0.179)$
$\log(y) = -0.276 - 42.154x^2 + 1.416\log(x)$
Curve fit for extrapolation $(-0.800<x<-0.250)$
$\log(y) = 0.891 - 18.618x$

Curve fit for original data $(0.161<x<0.350)$
$\log(y) = -3.123 - 9.760x^2 - 2.023\log(x)$
Curve fit for extrapolation $(0.350<x<1.700)$
$\log(y) = -0.126 - 9.342x$

Figure C-28 Load Spectra for Airplane 12^2, Single-Engine, Business/Personal

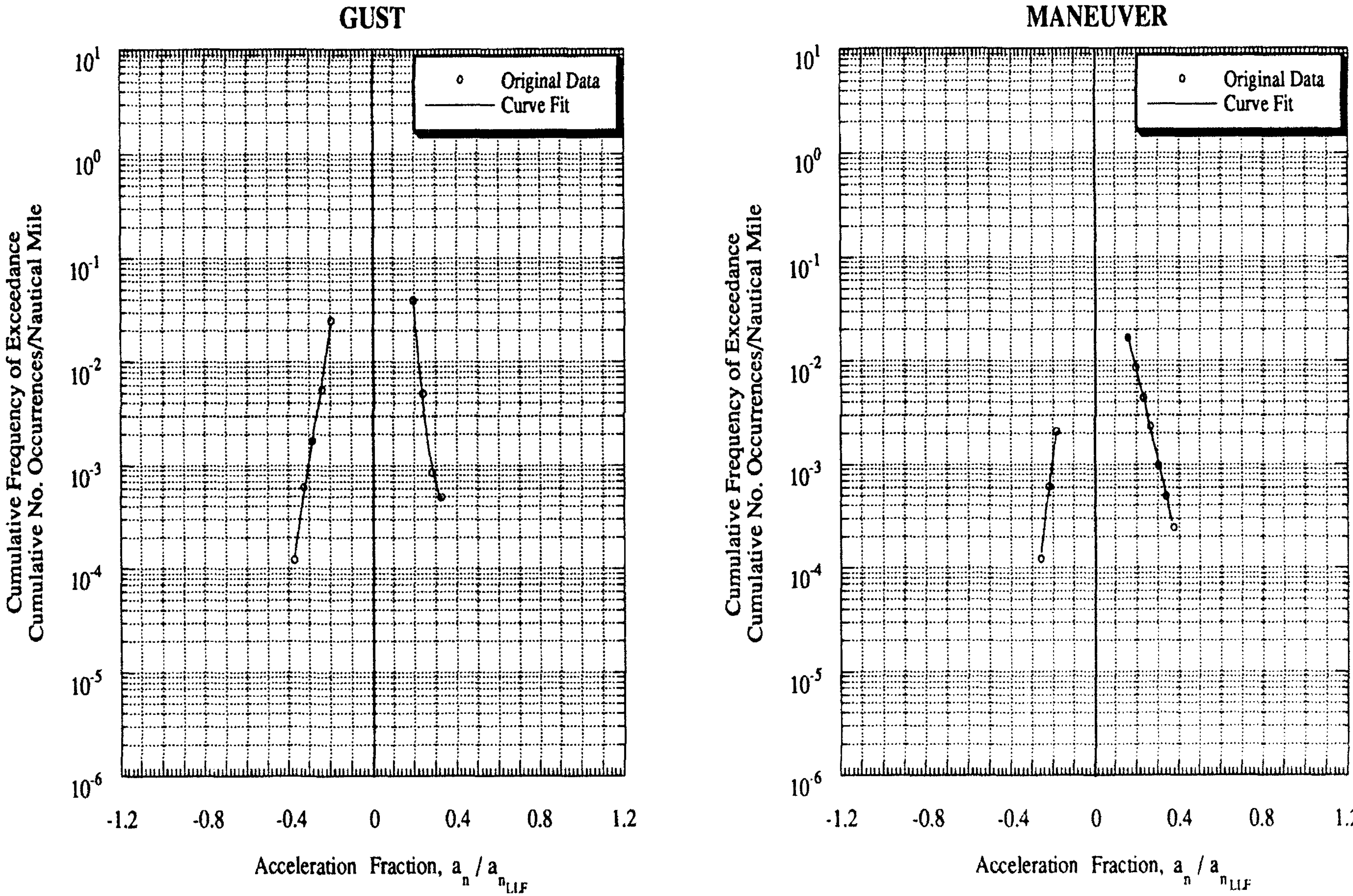


Table C-29 Tabulated Data for Airplane 12[3]

Total Nautical Miles = 19192 **Total Hours = 193**

GUST				MANEUVER			
negative		positive		negative		positive	
Acceleration Fraction	Cumulative Frequency of Exceedance	Acceleration Fraction	Cumulative Frequency of Exceedance	Acceleration Fraction	Cumulative Frequency of Exceedance	Acceleration Fraction	Cumulative Frequency of Exceedance
-0.200	0.1066760	0.200	0.0666202	-0.200	0.0073946	0.150	0.0544551
-0.250	0.0221391	0.250	0.0118041	-0.250	0.0027193	0.200	0.0133517
-0.300	0.0056541	0.300	0.0025424	-0.300	0.0010488	0.250	0.0039149
-0.350	0.0016438	0.350	0.0006138	-0.350	0.0004086	0.300	0.0012498
-0.400	0.0005192	0.400	0.0001582	-0.400	0.0001572	0.350	0.0004132
-0.450	0.0001730			-0.450	0.5884E-04	0.400	0.0001373

NOTE: for curve fits x = |x|

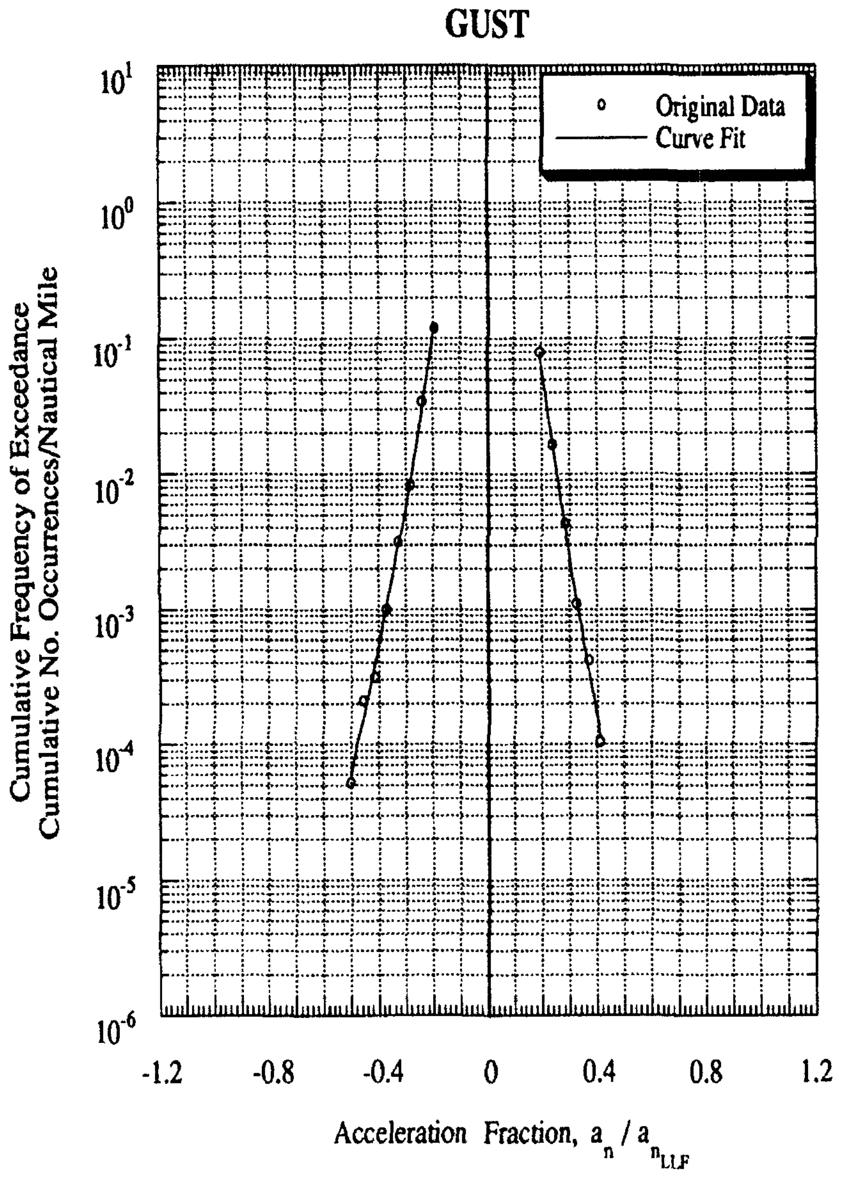
Curve fit for original data (-0.450<x<-0.196)
$\log(y) = -5.125 - 3.820x^2 - 6.160\log(x)$
Curve fit for extrapolation (-1.200<x<-0.450)
$\log(y) = 0.460 - 9.383x$

Curve fit for original data (0.196<x<0.400)
$\log(y) = -5.428 - 5.782x^2 - 6.413\log(x)$
Curve fit for extrapolation (0.400<x<1.667)
$\log(y) = 0.835 - 11.588x$

Curve fit for original data (-0.450<x<-0.179)
$\log(y) = -3.961 - 6.446x^2 - 2.987\log(x)$
Curve fit for extrapolation (-0.800<x<-0.450)
$\log(y) = -0.323 - 8.684x$

Curve fit for original data (0.161<x<0.400)
$\log(y) = -4.374 - 6.641x^2 - 3.956\log(x)$
Curve fit for extrapolation (0.400<x<1.700)
$\log(y) = -0.019 - 9.608x$

Figure C-29 Load Spectra for Airplane 12[3], Single-Engine, Business/Personal



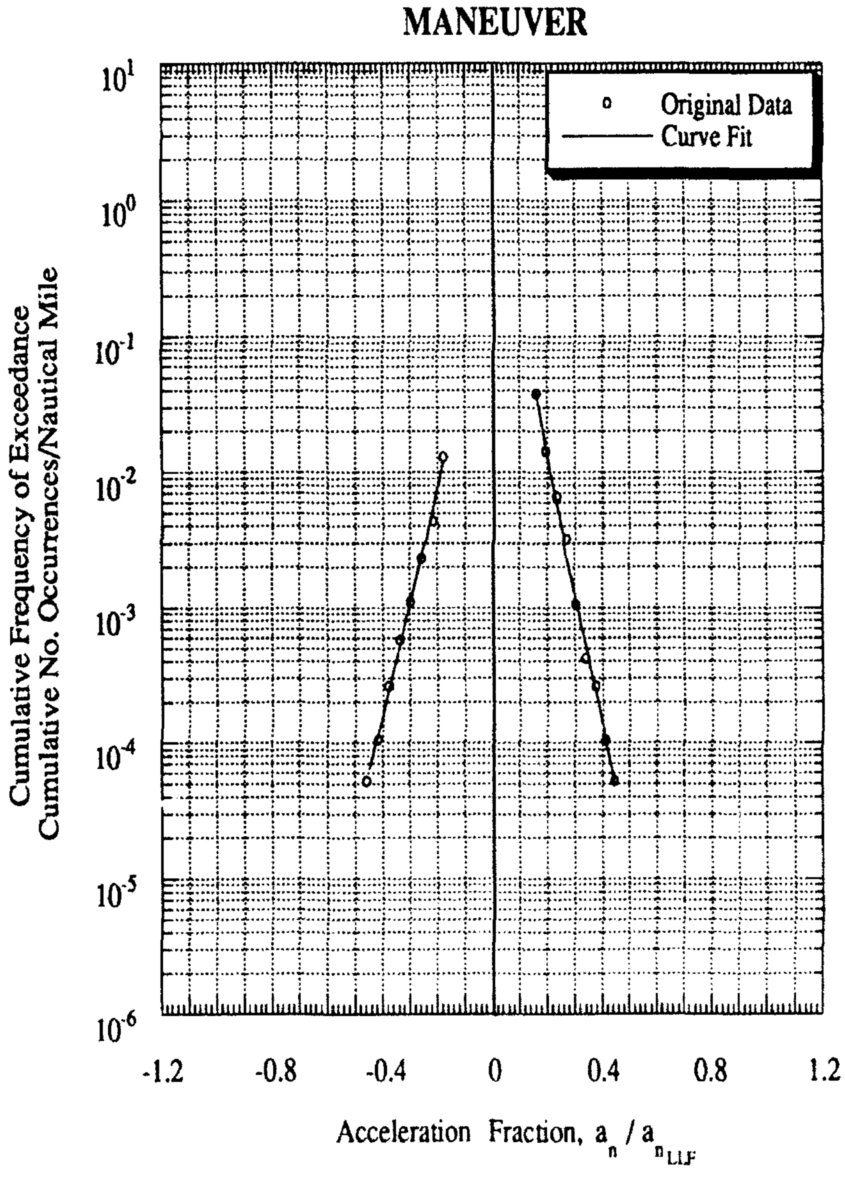


Table C-30 Tabulated Data for Airplane 12A

Total Nautical Miles = 3141 Total Hours = 34

GUST				MANEUVER			
negative		positive		negative		positive	
Acceleration Fraction	Cumulative Frequency of Exceedance	Acceleration Fraction	Cumulative Frequency of Exceedance	Acceleration Fraction	Cumulative Frequency of Exceedance	Acceleration Fraction	Cumulative Frequency of Exceedance
-0.200	0.0649354	0.200	0.0645972	-0.200	0.0053497	0.150	0.0286802
-0.250	0.0137951	0.250	0.0108743	-0.250	0.0028326	0.200	0.0158086
-0.300	0.0036481	0.300	0.0027019	-0.300	0.0013088	0.250	0.0091763
-0.350	0.0011099	0.350	0.0008878	-0.350	0.0005274	0.300	0.0054116
-0.400	0.0003706	0.400	0.0003612			0.350	0.0031810
		0.450	0.0001611			0.400	0.0018425
						0.450	0.0010440
						0.500	0.0005757
						0.550	0.0003128

NOTE: for curve fits $x = |x|$

Curve fit for original data $(-0.400 < x < -0.196)$
$\log(y) = -5.419 - 3.069x^2 - 6.229\log(x)$
Curve fit for extrapolation $(-1.200 < x < -0.400)$
$\log(y) = 0.256 - 9.219x$

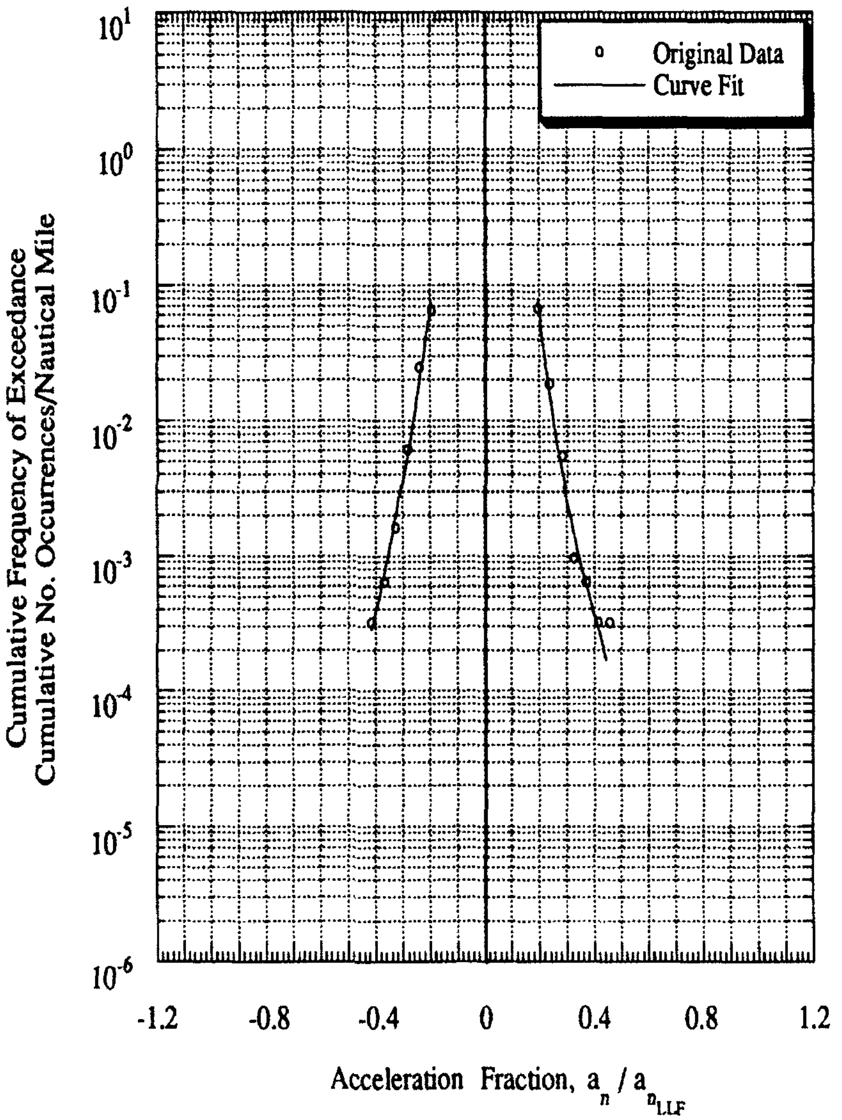
Curve fit for original data $(0.196 < x < 0.400)$
$\log(y) = -7.382 + 3.019x^2 - 8.686\log(x)$
Curve fit for extrapolation $(0.400 < x < 1.667)$
$\log(y) = -0.636 - 7.015x$

Curve fit for original data $(-0.350 < x < -0.179)$
$\log(y) = -1.830 - 12.030x^2 - 0.056\log(x)$
Curve fit for extrapolation $(-0.800 < x < -0.350)$
$\log(y) = -0.306 - 8.491x$

Curve fit for original data $(0.161 < x < 0.500)$
$\log(y) = -2.699 - 3.985x^2 - 1.512\log(x)$
Curve fit for extrapolation $(0.500 < x < 1.700)$
$\log(y) = -0.590 - 5.299x$

Figure C-30 Load Spectra for Airplane 12A, Single-Engine, Business/Personal

GUST



MANEUVER

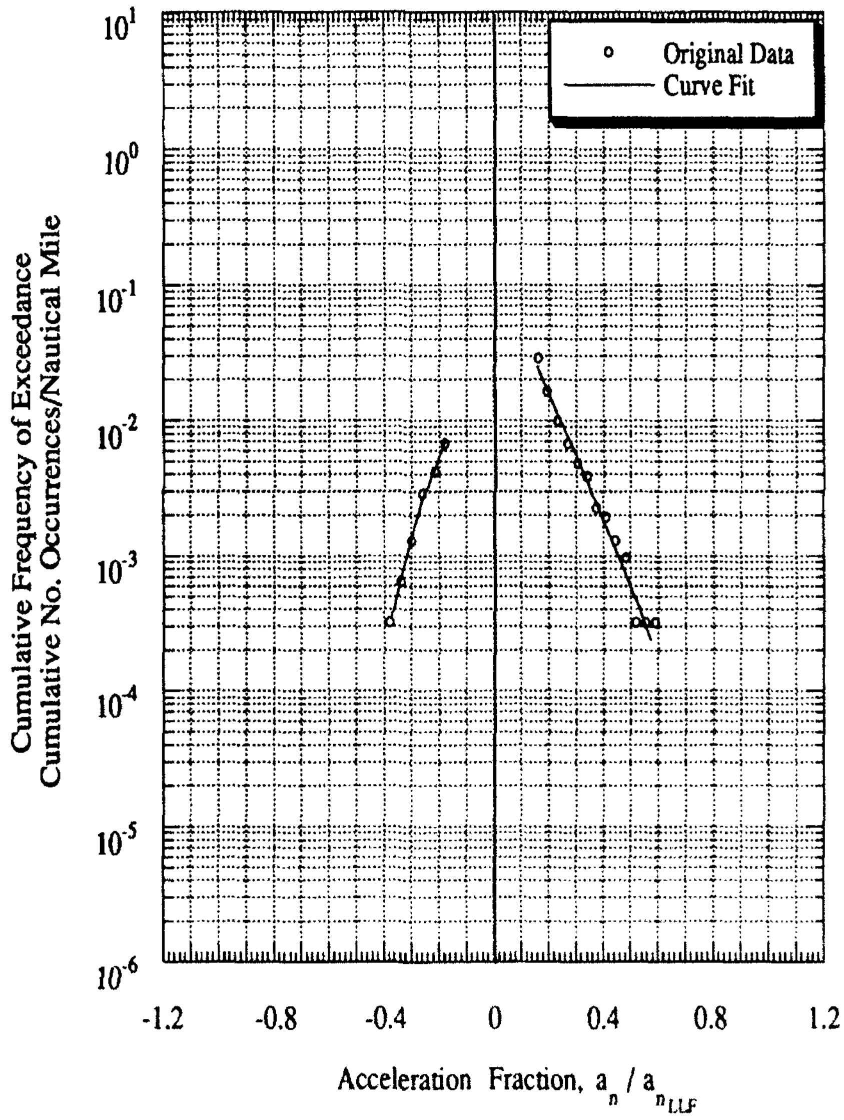


Table C-31 Tabulated Data for Airplane 13

Total Nautical Miles = 75331 Total Hours = 782

GUST negative Acceleration Fraction	GUST negative Cumulative Frequency of Exceedance	GUST positive Acceleration Fraction	GUST positive Cumulative Frequency of Exceedance	MANEUVER negative Acceleration Fraction	MANEUVER negative Cumulative Frequency of Exceedance	MANEUVER positive Acceleration Fraction	MANEUVER positive Cumulative Frequency of Exceedance
-0.200	0.0379344	0.200	0.0398620	-0.200	0.0028289	0.150	0.0172017
-0.250	0.0100258	0.250	0.0069639	-0.250	0.0011686	0.200	0.0075871
-0.300	0.0030415	0.300	0.0016055	-0.300	0.0005135	0.250	0.0031890
-0.350	0.0009968	0.350	0.0004450	-0.350	0.0002315	0.300	0.0012396
-0.400	0.0003403	0.400	0.0001403	-0.400	0.0001048	0.350	0.0004385
-0.450	0.0001183	0.450	0.4854E-04	-0.450	0.4698E-04	0.400	0.0001398
-0.500	0.4117E-04	0.500	0.1798E-04			0.450	0.4224E-04
		0.550	0.6851E-05			0.500	0.1276E-04
		0.600	0.2610E-05			0.550	0.3855E-05
						0.600	0.1165E-05

NOTE: for curve fits $x = |x|$

Curve fit for original data $(-0.500<x<-0.188)$
$\log(y) = -4.572 - 5.028x^2 - 4.796\log(x)$
Curve fit for extrapolation $(-1.200<x<-0.500)$
$\log(y) = 0.212 - 9.194x$

Curve fit for original data $(0.188<x<0.500)$
$\log(y) = -6.461 - 1.993x^2 - 7.356\log(x)$
Curve fit for extrapolation $(0.500<x<1.667)$
$\log(y) = -0.554 - 8.382x$

Curve fit for original data $(-0.450<x<-0.179)$
$\log(y) = -4.354 - 4.762x^2 - 2.856\log(x)$
Curve fit for extrapolation $(-0.800<x<-0.450)$
$\log(y) = -1.159 - 7.042x$

Curve fit for original data $(0.161<x<0.400)$
$\log(y) = -2.553 - 11.279x^2 - 1.266\log(x)$
Curve fit for extrapolation $(0.400<x<1.700)$
$\log(y) = 0.305 - 10.397x$

Figure C-31 Load Spectra for Airplane 13, Single-Engine, Business/Personal

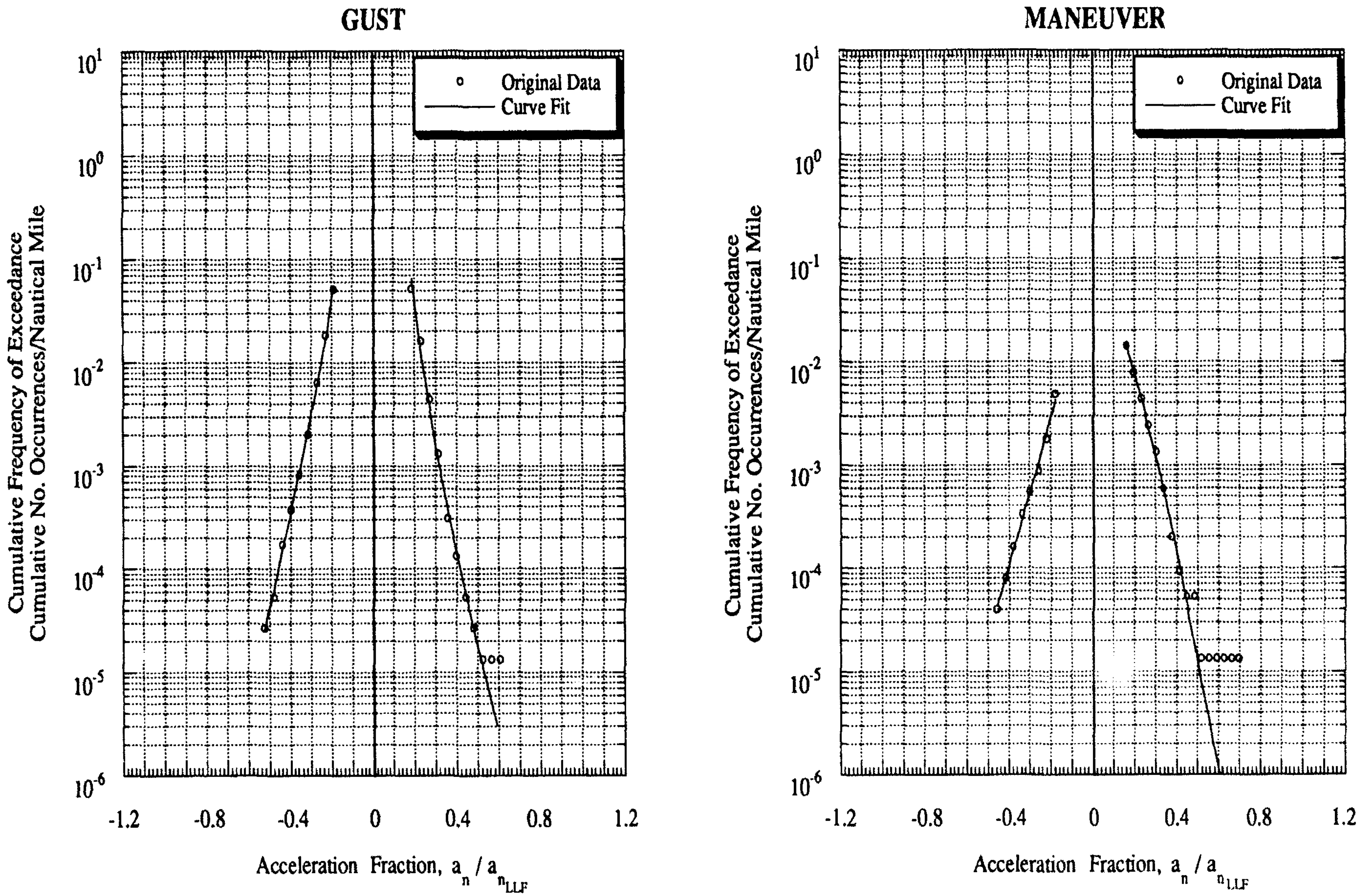


Table C-32 Tabulated Data for Airplane 13[1]

Total Nautical Miles = 11290   Total Hours = 123

GUST negative Acceleration Fraction	GUST negative Cumulative Frequency of Exceedance	GUST positive Acceleration Fraction	GUST positive Cumulative Frequency of Exceedance	MANEUVER negative Acceleration Fraction	MANEUVER negative Cumulative Frequency of Exceedance	MANEUVER positive Acceleration Fraction	MANEUVER positive Cumulative Frequency of Exceedance
-0.200	0.0578506	0.200	0.0544594	-0.200	0.0021397	0.150	0.0110202
-0.250	0.0109124	0.250	0.0116669	-0.250	0.0009354	0.200	0.0066219
-0.300	0.0027843	0.300	0.0034356	-0.300	0.0003402	0.250	0.0033918
-0.350	0.0008746	0.350	0.0012679			0.300	0.0014843
-0.400	0.0003197	0.400	0.0005549			0.350	0.0005556
-0.450	0.0001312	0.450	0.0002779			0.400	0.0001780
-0.500	0.5653E-04	0.500	0.0001555				
-0.550	0.2435E-04	0.550	0.9139E-04				
		0.600	0.5370E-04				

NOTE: for curve fits x = |x|

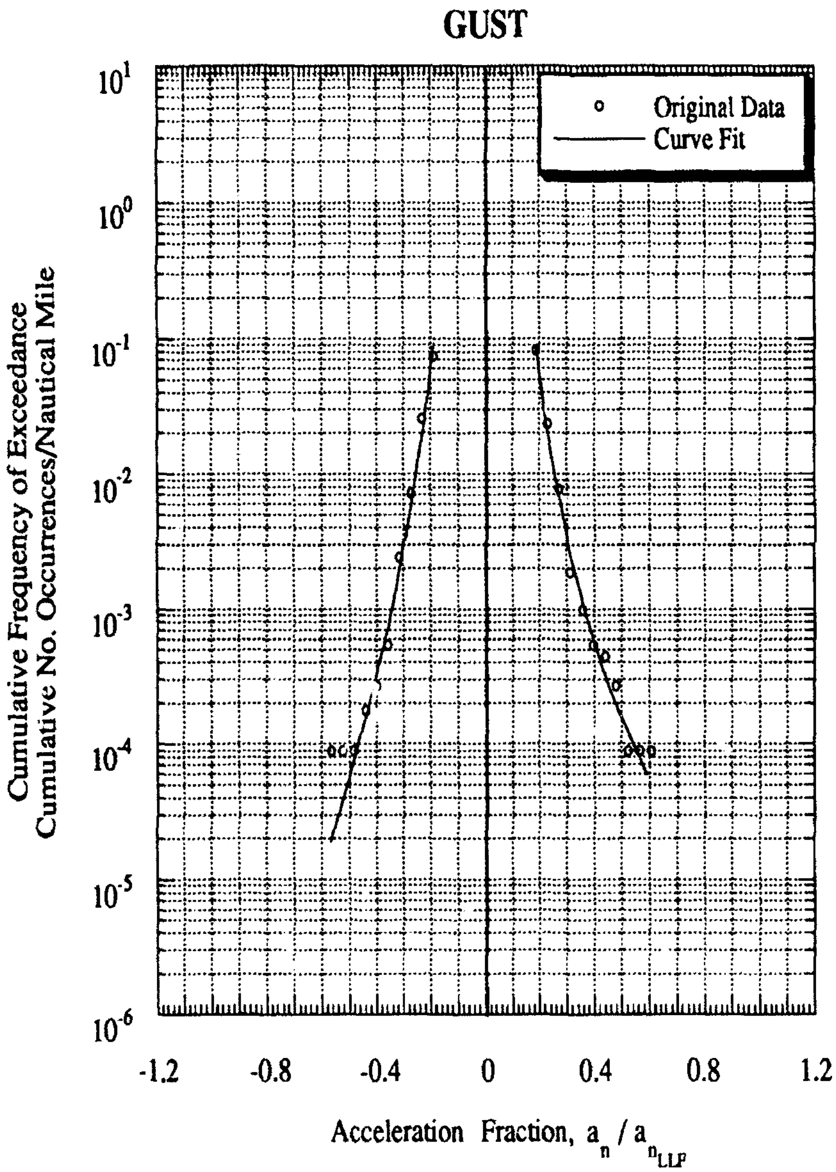
Gust negative:
Curve fit for original data $(-0.450 < x < -0.188)$
$\log(y) = -6.433 - 0.147x^2 - 7.441\log(x)$
Curve fit for extrapolation $(-1.200 < x < -0.450)$
$\log(y) = -0.591 - 7.313x$

Gust positive:
Curve fit for original data $(0.188 < x < 0.500)$
$\log(y) = -6.440 + 1.728x^2 - 7.306\log(x)$
Curve fit for extrapolation $(0.500 < x < 1.667)$
$\log(y) = -1.500 - 4.617x$

Maneuver negative:
Curve fit for original data $(-0.300 < x < -0.179)$
$\log(y) = -2.031 - 15.972x^2$
Curve fit for extrapolation $(-0.800 < x < -0.300)$
$\log(y) = -2.031 - 15.972x^2$

Maneuver positive:
Curve fit for original data $(0.161 < x < 0.400)$
$\log(y) = -1.578 - 13.329x^2 + 0.096\log(x)$
Curve fit for extrapolation $(0.400 < x < 1.700)$
$\log(y) = 0.474 - 10.559x$

Figure C-32 Load Spectra for Airplane 13[1], Single-Engine, Business/Personal



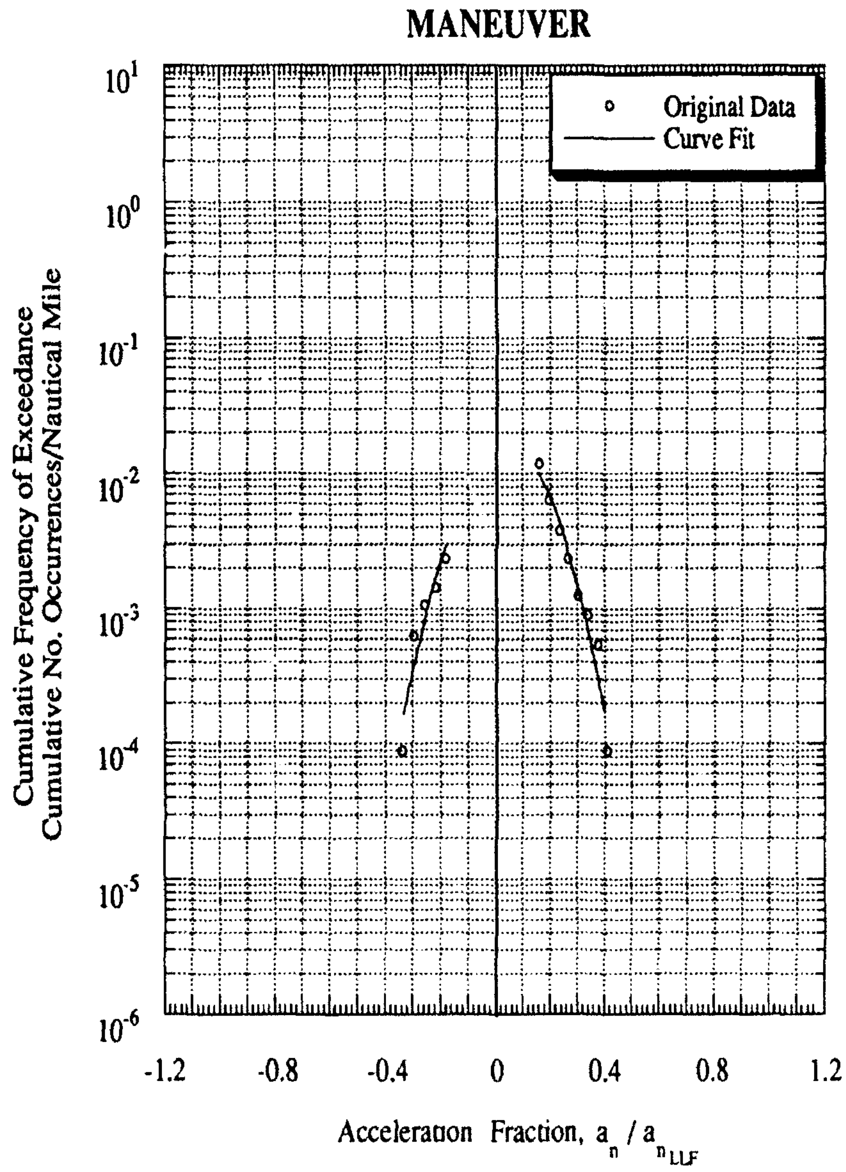


Table C-33 Tabulated Data for Airplane 28

Total Nautical Miles = 54312 Total Hours = 888

GUST				MANEUVER			
negative		positive		negative		positive	
Acceleration Fraction	Cumulative Frequency of Exceedance	Acceleration Fraction	Cumulative Frequency of Exceedance	Acceleration Fraction	Cumulative Frequency of Exceedance	Acceleration Fraction	Cumulative Frequency of Exceedance
-0.100	0.0191765	0.100	0.0270981	-0.100	0.0182349	0.050	0.3346986
-0.150	0.0039688	0.150	0.0051288	-0.150	0.0004935	0.100	0.0171562
-0.200	0.0011721	0.200	0.0013638	-0.200	0.0001423	0.15[illegible]	0.0026306
-0.250	0.0004096	0.250	0.0004208	-0.250	0.6218E-04	0.2[illegible]	0.0006009
-0.300	0.0001558	0.300	0.0001383			0.250	0.0001644
-0.350	0.6165E-04	0.350	0.4630E-04			0.300	0.4885E-04
-0.400	0.2474E-04	0.400	0.1536E-04			0.350	0.1484E-04
-0.450	0.9930E-05						

NOTE: for curve fits x = |x|

Curve fit for original data (-0.400<x<-0.097)
$\log(y) = -5.187 - 5.132x^2 - 3.521\log(x)$
Curve fit for extrapolation (-1.200<x<-0.400)
$\log(y) = -1.436 - 7.928x$

Curve fit for original data (0.097<x<0.400)
$\log(y) = -5.087 - 7.225x^2 - 3.593\log(x)$
Curve fit for extrapolation (0.400<x<1.667)
$\log(y) = -0.942 - 9.680x$

Curve fit for original data (-0.250≤x<-0.091)
$\log(y) = -50.66 + 139.91x - 169.16x^2 - 36.62\log(x)$
Curve fit for extrapolation (-0.800<x<-0.250)
$\log(y) = -2.135 - 8.286x$

Curve fit for original data (0.074<x<0.300)
$\log(y) = -5.795 - 7.350x^2 - 4.103\log(x)$
Curve fit for extrapolation (0.300<x<1.700)
$\log(y) = -1.206 - 10.350x$

Figure C-33 Load Spectra for Airplane 28, Single-Engine, Business/Personal

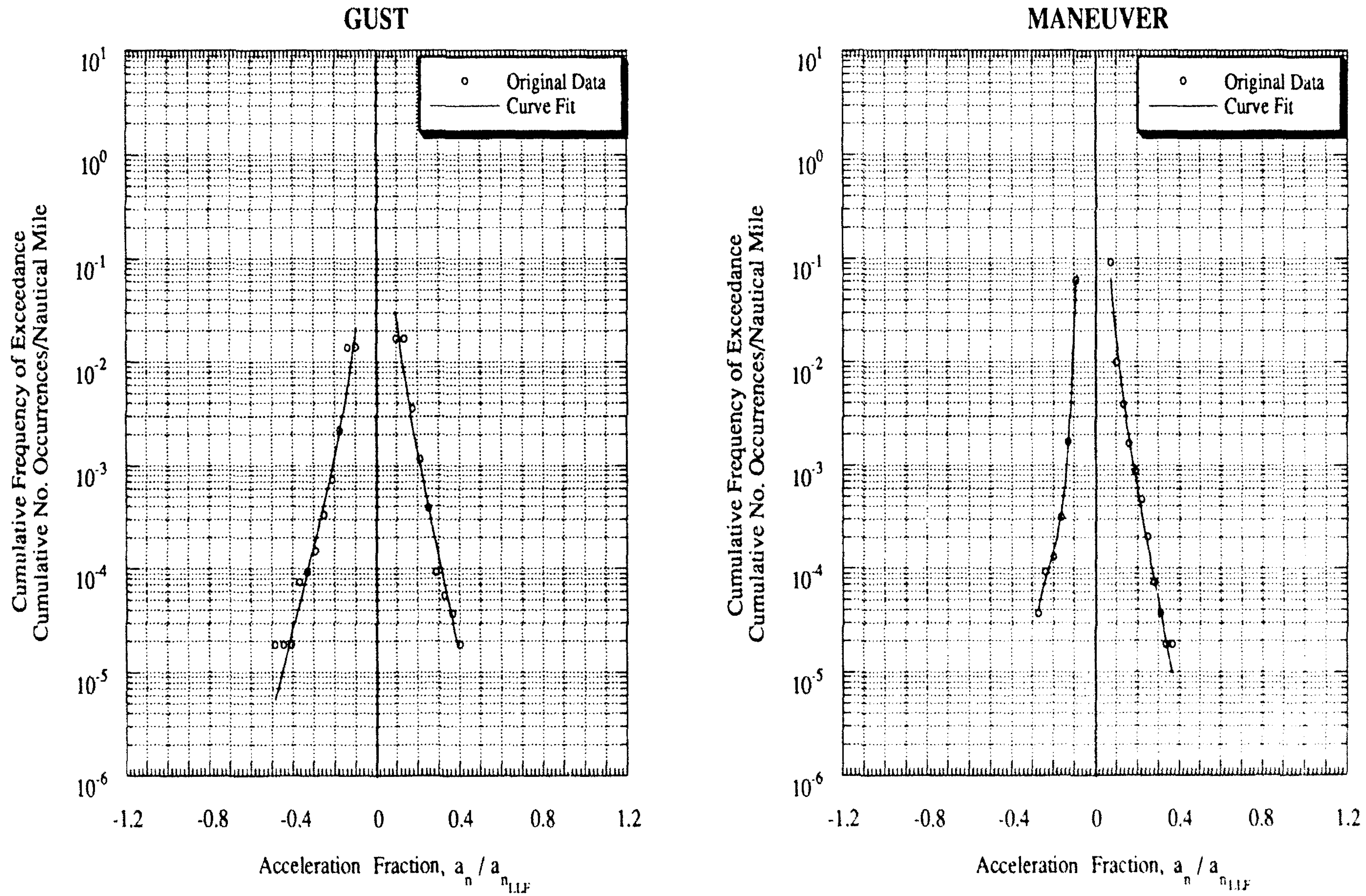


Table C-34 Tabulated Data for Airplane 41

Total Nautical Miles = 129065 Total Hours = 1285

GUST				MANEUVER			
negative		positive		negative		positive	
Acceleration Fraction	Cumulative Frequency of Exceedance	Acceleration Fraction	Cumulative Frequency of Exceedance	Acceleration Fraction	Cumulative Frequency of Exceedance	Acceleration Fraction	Cumulative Frequency of Exceedance
-0.200	0.0064303	0.200	0.0098877	-0.250	0.0046903	0.200	0.0111285
-0.250	0.0020448	0.250	0.0032730	-0.300	0.0013226	0.250	0.0026239
-0.300	0.0007465	0.300	0.0013149	-0.350	0.0004638	0.300	0.0008089
-0.350	0.0002961	0.350	0.0006029	-0.400	0.0001914	0.350	0.0003002
-0.400	0.0001235	0.400	0.0003042	-0.450	0.8967E-04	0.400	0.0001277
-0.450	0.5304E-04	0.450	0.0001649	-0.500	0.4656E-04	0.450	0.6033E-04
-0.500	0.2312E-04	0.500	0.9448E-04	-0.550	0.2634E-04	0.500	0.2979E-04
-0.550	0.1012E-04	0.550	0.5658E-04			0.550	0.1471E-04
		0.600	0.3512E-04			0.600	0.7266E-05
		0.650	0.2244E-04			0.650	0.3588E-05
		0.700	0.1452E-04			0.700	0.1772E-05
		0.750	0.9400E-05				
		0.800	0.6084E-05				
		0.850	0.3938E-05				
		0.900	0.2549E-05				
		0.950	0.1650E-05				
		1.000	0.1068E-05				

NOTE: for curve fits x = |x|

Curve fit original data ($-0.550 < x < -0.188$)
$\log(y) = -5.091 - 3.411x^2 - 4.343\log(x)$
Curve fit for extrapolation ($-1.200 < x < -0.550$)
$\log(y) = -1.046 - 7.181x$

Curve fit original data ($0.205 < x < 0.650$)
$\log(y) = -5.385 - 0.409x^2 - 4.860\log(x)$
Curve fit for extrapolation ($0.650 < x < 1.667$)
$\log(y) = -2.193 - 3.779x$

Curve fit original data ($-0.550 < x < -0.225$)
$\log(y) = -6.793 + 1.048x^2 - 7.307\log(x)$
Curve fit for extrapolation ($-0.800 < x < -0.550$)
$\log(y) = -2.040 - 4.617x$

Curve fit original data ($0.180 < x < 0.450$)
$\log(y) = -6.515 + 0.179x^2 - 6.516\log(x)$
Curve fit for extrapolation ($0.450 < x < 1.700$)
$\log(y) = -1.462 - 6.128x$

Figure C-34 Load Spectra for Airplane 41, Single-Engine, Business/Personal

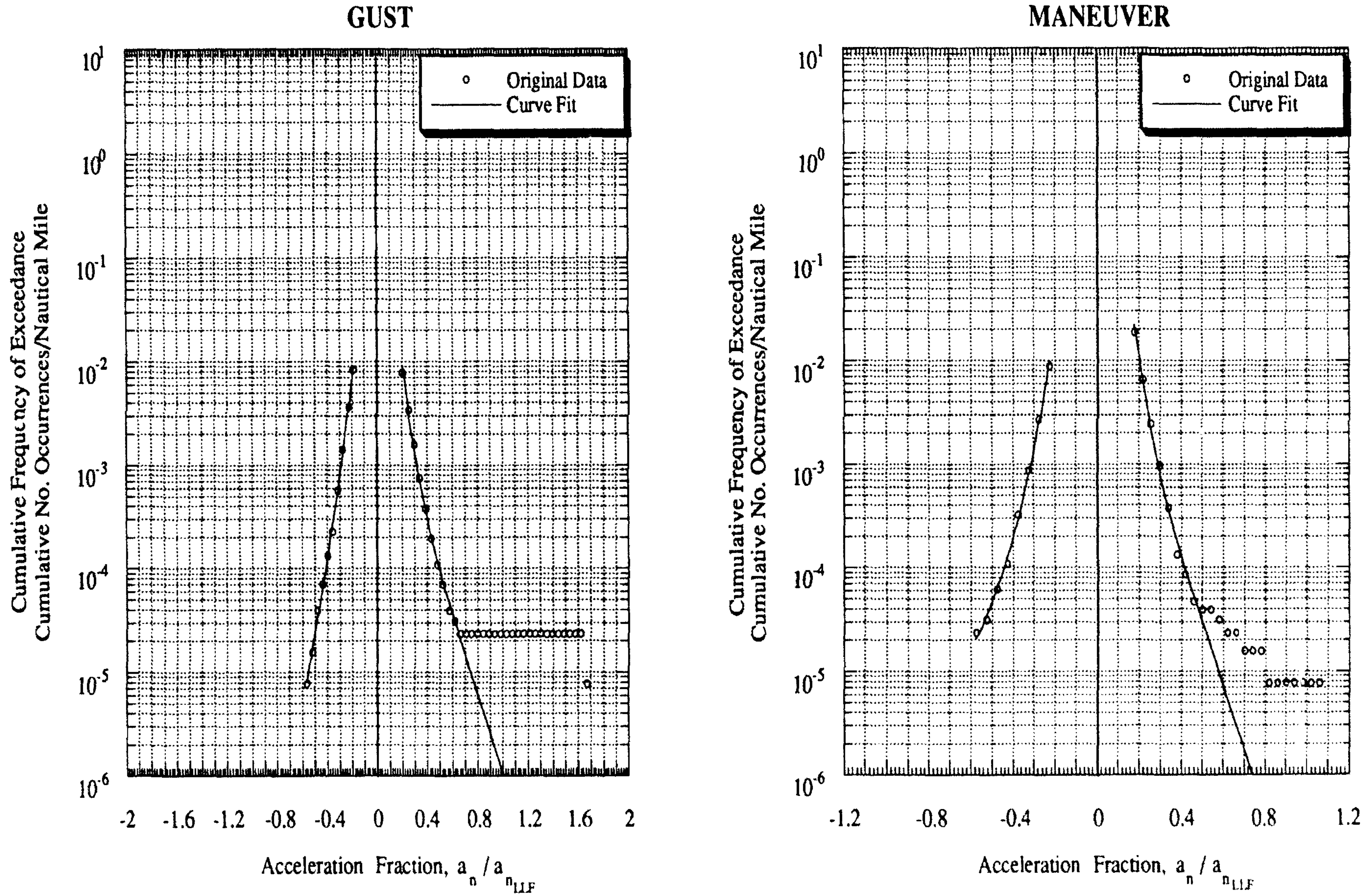


Table C-35 Tabulated Data for Airplane 6A

Total Nautical Miles = 209750 **Total Hours = 1380**

GUST negative: Acceleration Fraction	GUST negative: Cumulative Frequency of Exceedance	GUST positive: Acceleration Fraction	GUST positive: Cumulative Frequency of Exceedance	MANEUVER negative: Acceleration Fraction	MANEUVER negative: Cumulative Frequency of Exceedance	MANEUVER positive: Acceleration Fraction	MANEUVER positive: Cumulative Frequency of Exceedance
-0.200	0.3335950	0.200	0.3770342	-0.200	0.0657484	0.150	0.3394602
-0.250	0.0884207	0.250	0.1117740	-0.250	0.0150804	0.200	0.1291976
-0.300	0.0288883	0.300	0.0402630	-0.300	0.0041982	0.250	0.0532401
-0.350	0.0108414	0.350	0.0165127	-0.350	0.0013188	0.300	0.0224279
-0.400	0.0044807	0.400	0.0074167	-0.400	0.0004475	0.350	0.0093668
-0.450	0.0019848	0.450	0.0035579	-0.450	0.0001595	0.400	0.0038081
-0.500	0.0009250	0.500	0.0017921	-0.500	0.5861E-04	0.450	0.0014894
-0.550	0.0004476	0.550	0.0009362			0.500	0.0005559
-0 600	0.0002227	0.600	0.0005028			0.550	0.0001969
-0.650	0.0001130	0.650	0.0002756			0.600	0.6587E-04
-0.700	0.5824E-04	0.700	0.0001535			0.650	0.2076E-04
-0.750	0.3030E-04	0.750	0.8640E-04			0.700	0.6341E-05
-0.800	0.1587E-04	0.800	0.4902E-04			0.750	0.1937E-05
-0.850	0.8337E-05	0.850	0.2795E-04				
-0.900	0.4384E-05	0.900	0.1597E-04				
-0.950	0.2305E-05	0.950	0.9119E-05				
-1.000	0.1212E-05	1.000	0.5209E-05				
		1.050	0.2975E-05				
		1.100	0.1699E-05				

NOTE: for curve fits x = |x|

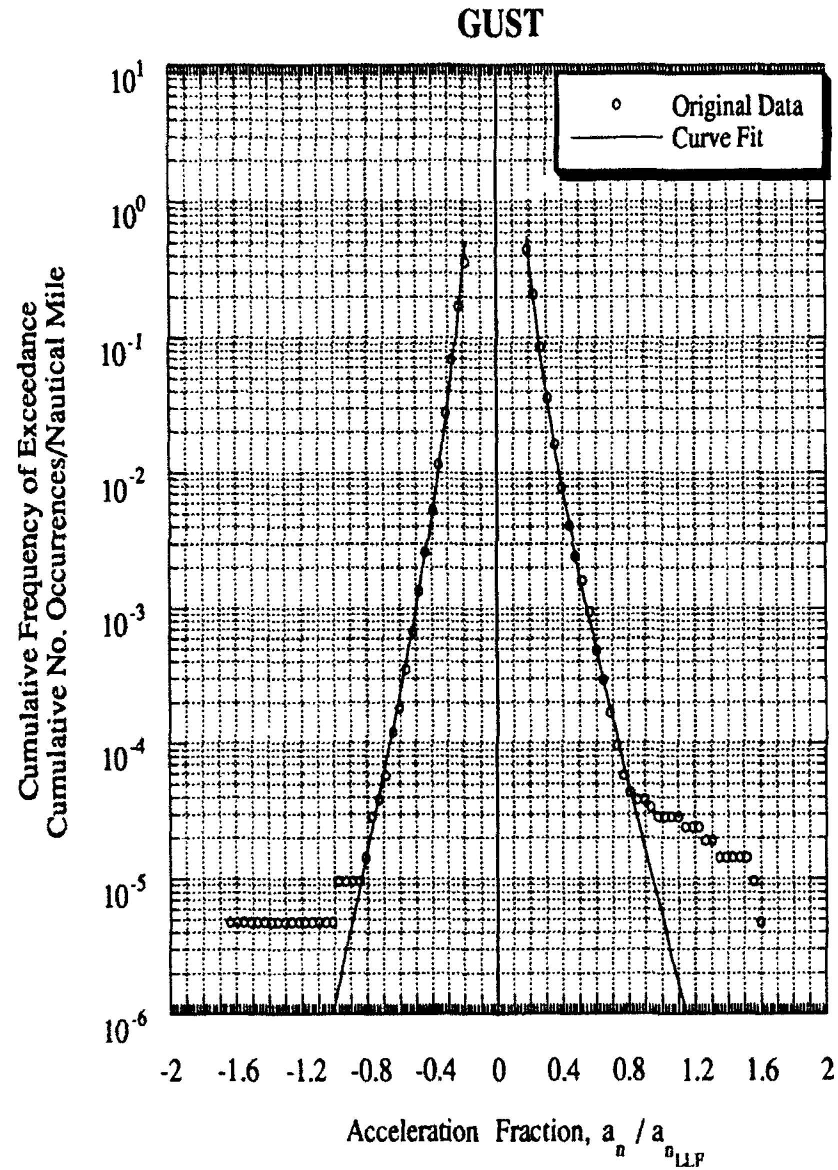
Curve fit original data (-0.850 < x < -0.187)
$\log(y) = -4.311 - 1.608x^2 - 5.577\log(x)$
Curve fit for extrapolation (-1.650 < x < -0.850)
$\log(y) = -0.333 - 5.583x$

Curve fit original data (0.187 < x < 0.850)
$\log(y) = -3.966 - 1.316x^2 - 5.143\log(x)$
Curve fit for extrapolation (0.850 < x < 1.600)
$\log(y) = -0.419 - 4.865x$

Curve fit original data (-0.500 < x < -0.179)
$\log(y) = -5.065 - 3.605x^2 - 5.762\log(x)$
Curve fit for extrapolation (-0.813 < x < -0.500)
$\log(y) = 0.073 - 8.610x$

Curve fit original data (0.161 < x < 0.650)
$\log(y) = -2.315 - 6.677x^2 - 2.423\log(x)$
Curve fit for extrapolation (0.650 < x < 1.500)
$\log(y) = 2.011 - 10.299x$

Figure C-35 Load Spectra for Airplane 6A, Single-Engine, Special Usage



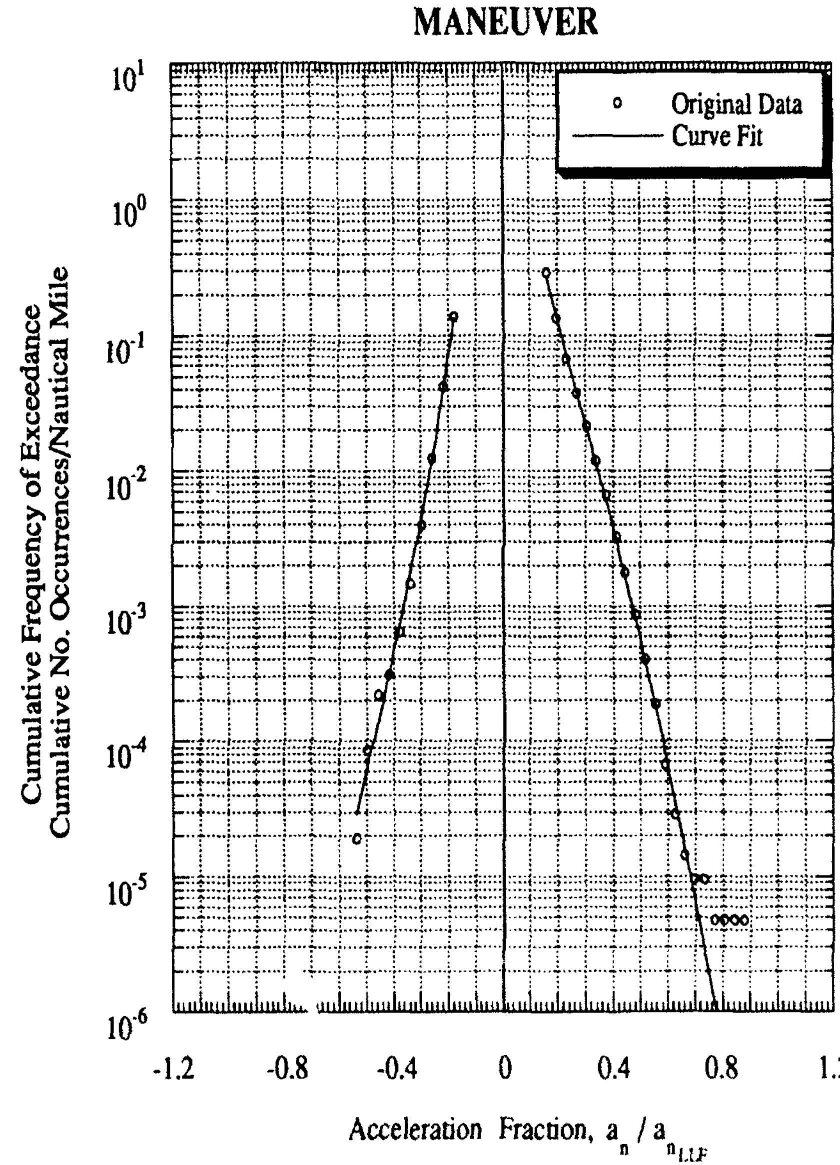


Table C-36 Tabulated Data for Airplane 9B

Total Nautical Miles = 82334 Total Hours = 740

GUST				MANEUVER			
negative		positive		negative		positive	
Acceleration Fraction	Cumulative Frequency of Exceedance	Acceleration Fraction	Cumulative Frequency of Exceedance	Acceleration Fraction	Cumulative Frequency of Exceedance	Acceleration Fraction	Cumulative Frequency of Exceedance
-0.200	0.1338738	0.200	0.1255507	-0.200	0.0005592	0.150	0.0056568
-0.250	0.0434474	0.250	0.0286020	-0.250	0.0002383	0.200	0.0029592
-0.300	0.0151109	0.300	0.0085827	-0.300	0.0001567	0.250	0.0015823
-0.350	0.0053861	0.350	0.0031174	-0.350	0.0001214	0.300	0.0008364
-0.400	0.0019157	0.400	0.0013031	-0.400	0.9442E-04	0.350	0.0004293
-0.450	0.0006683	0.450	0.0006068	-0.450	0.6647E-04	0.400	0.0002117
-0.500	0.0002260	0.500	0.0003078	-0.500	0.3946E-04	0.450	0.9961E-04
-0.550	0.7348E-04	0.550	0.0001675	-0.550	0.1878E-04	0.500	0.4451E-04
-0.600	0.2282E-04	0.600	0.9655E-04	-0.600	0.7898E-05	0.550	0.1936E-04
		0.650	0.5848E-04	-0.650	0.3322E-05	0.600	0.8421E-05
		0.700	0.3622E-04	-0.700	0.1397E-05	0.650	0.3663E-05
		0.750	0.2243E-04				

NOTE: for curve fits $x = |x|$

Curve fit original data $(-0.600 < x < -0.193)$
$\log(y) = -3.081 - 6.511x^2 - 3.532\log(x)$
Curve fit for extrapolation $(-1.650 < x < -0.600)$
$\log(y) = 1.580 - 10.369x$

Curve fit original data $(0.193 < x < 0.650)$
$\log(y) = -5.582 + 0.233x^2 - 6.683\log(x)$
Curve fit for extrapolation $(0.650 < x < 1.600)$
$\log(y) = -1.528 - 4.162x$

Curve fit original data $(-0.550 < x < -0.179)$
$\log(y) = -26.77 + 50.80x - 37.75x^2 - 21.27\log(x)$
Curve fit for extrapolation $(-0.813 < x < -0.550)$
$\log(y) = -0.588 - 7.523x$

Curve fit original data $(0.161 < x < 0.500)$
$\log(y) = -3.275 - 6.005x^2 - 1.411\log(x)$
Curve fit for extrapolation $(0.500 < x < 1.500)$
$\log(y) = -0.736 - 7.231x$

Figure C-36 Load Spectra for Airplane 9B, Single-Engine, Special Usage

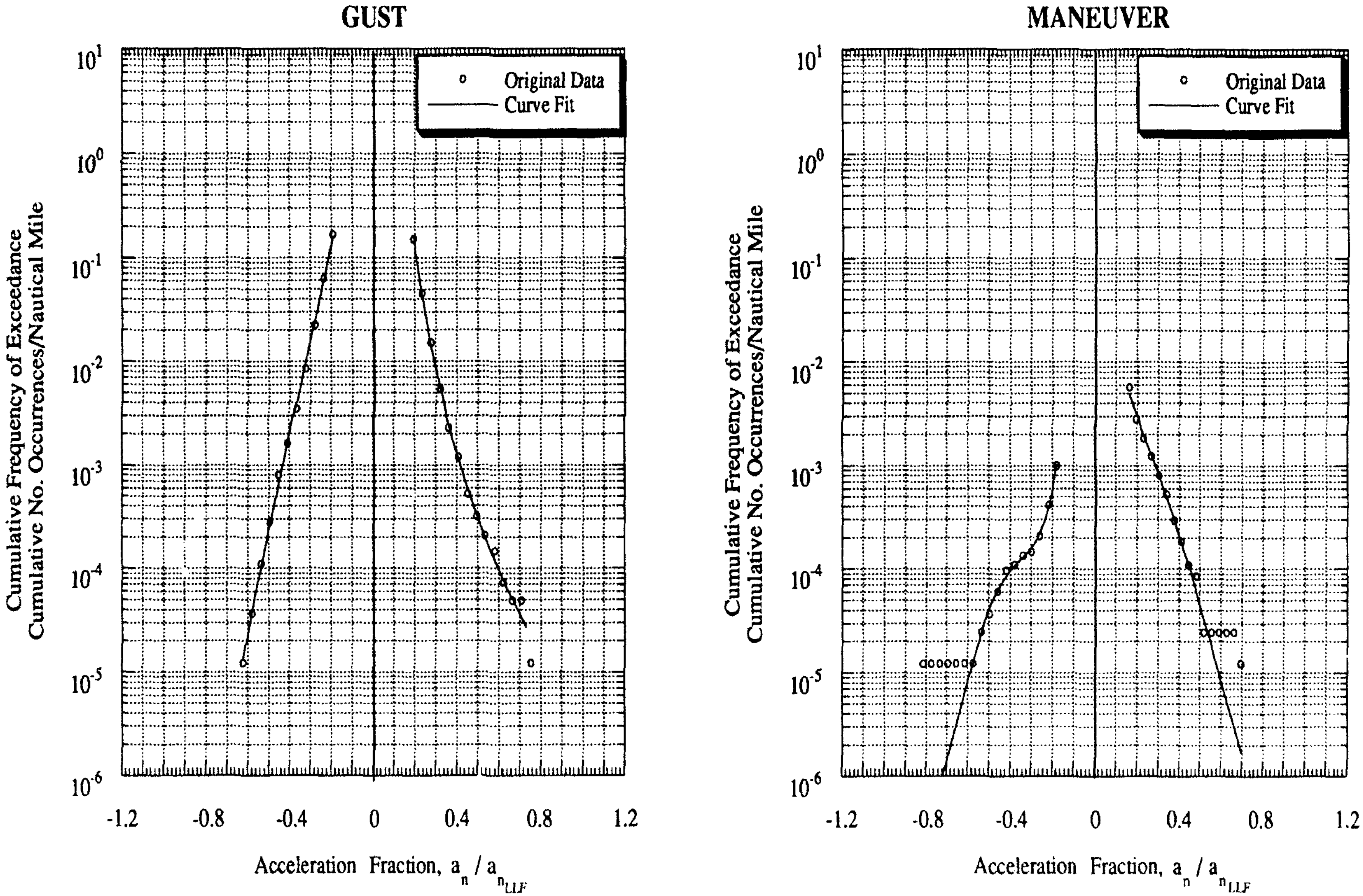


Table C-37 Tabulated Data for Airplane 17[1]

Total Nautical Miles = 111407 Total Hours = 1258

GUST negative		GUST positive		MANEUVER negative		MANEUVER positive	
Acceleration Fraction	Cumulative Frequency of Exceedance	Acceleration Fraction	Cumulative Frequency of Exceedance	Acceleration Fraction	Cumulative Frequency of Exceedance	Acceleration Fraction	Cumulative Frequency of Exceedance
-0.200	1.1467170	0.200	1.0565190	-0.150	0.0008020	0.150	0.2172265
-0.250	0.2902523	0.250	0.1899555	-0.200	0.0001301	0.200	0.1381743
-0.300	0.0885439	0.300	0.0417285	-0.250	0.5153E-04	0.250	0.0728134
-0.350	0.0303884	0.350	0.0103245	-0.300	0.2922E-04	0.300	0.0320923
-0.400	0.0112610	0.400	0.0027407	-0.350	0.1656E-04	0.350	0.0118906
-0.450	0.0043879	0.450	0.0007565	-0.400	0.9392E-05	0.400	0.0037148
-0.500	0.0017655	0.500	0.0002125			0.450	0.0009805
-0.550	0.0007242	0.550	0.5985E-04			0.500	0.0002189
-0.600	0.0002999	0.600	0.1670E-04			0.550	0.4140E-04
-0.650	0.0001245	0.650	0.4627E-05			0.600	0.7204E-05
-0.700	0.5153E-04	0.700	0.1282E-05				
-0.750	0.2117E-04						
-0.800	0.8649E-05						
-0.850	0.3534E-05						

NOTE: *for curve fits* $x = |x|$

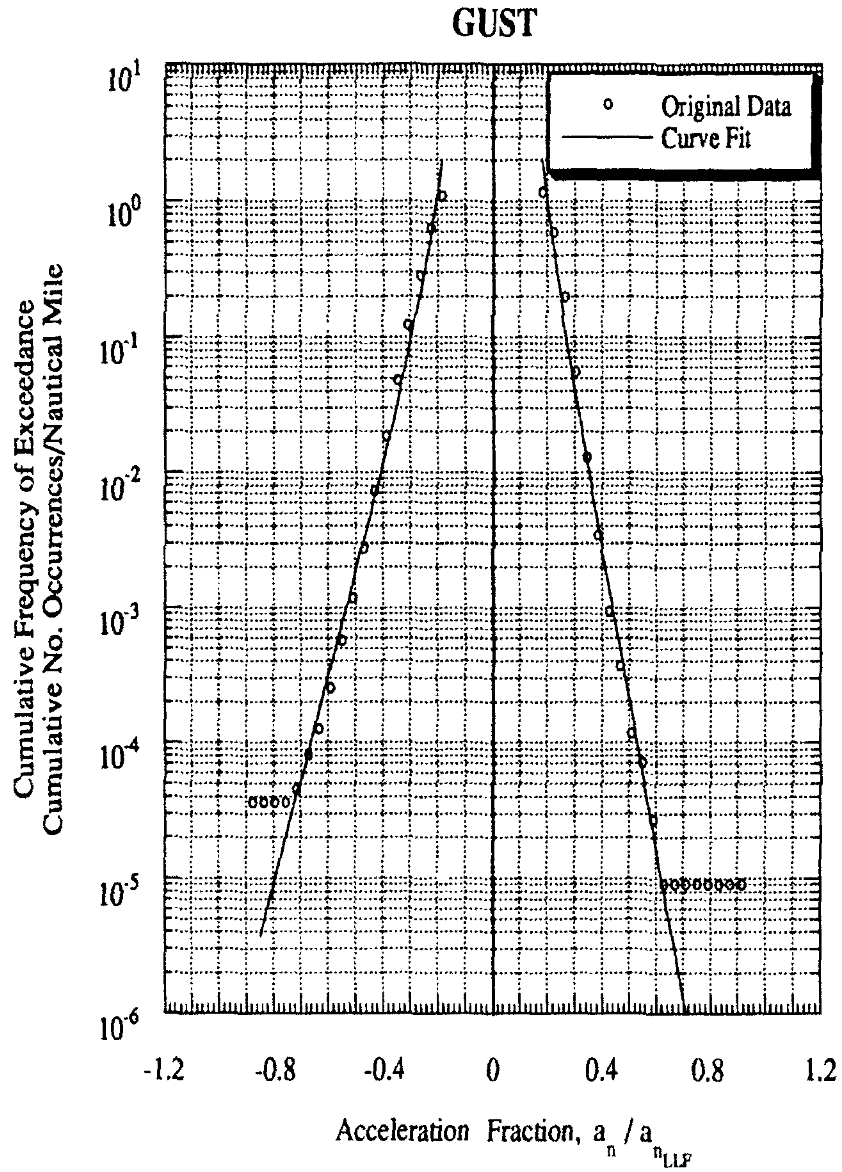
Curve fit original data $(-0.750 < x < -0.183)$
$\log(y) = -3.621 - 3.082x^2 - 5.442\log(x)$
Curve fit for extrapolation $(-1.650 < x < -0.750)$
$\log(y) = 1.156 - 7.774x$

Curve fit original data $(0.183 < x < 0.600)$
$\log(y) = -4.257 - 5.411x^2 - 6.434\log(x)$
Curve fit for extrapolation $(0.600 < x < 1.600)$
$\log(y) = 1.913 - 11.150x$

Curve fit original data $(-0.250 < x < -0.163)$
$\log(y) = -11.559 + 23.591x^2 - 9.627\log(x)$
Curve fit for extrapolation $(-0.813 < x < -0.250)$
$\log(y) = -3.056 - 4.929x$

Curve fit original data $(0.132 < x < 0.550)$
$\log(y) = -0.015 - 14.095x^2 + 0.402\log(x)$
Curve fit for extrapolation $(0.550 < x < 1.500)$
$\log(y) = 3.970 - 15.187x$

Figure C-37 Load Spectra for Airplane 17[1], Single-Engine, Special Usage



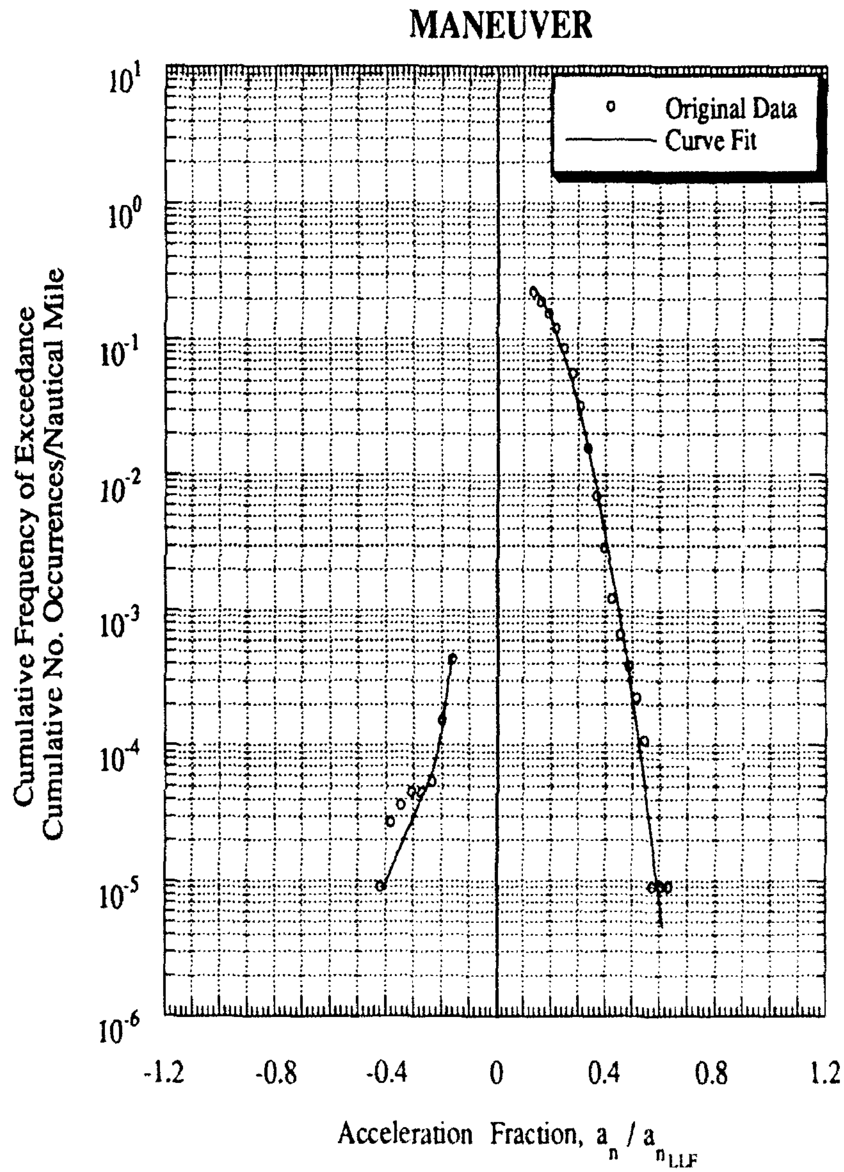


Table C-38 Tabulated Data for Airplane 27

Total Nautical Miles = 31187 **Total Hours = 253**

GUST				MANEUVER			
negative		positive		negative		positive	
Acceleration Fraction	Cumulative Frequency of Exceedance	Acceleration Fraction	Cumulative Frequency of Exceedance	Acceleration Fraction	Cumulative Frequency of Exceedance	Acceleration Fraction	Cumulative Frequency of Exceedance
-0.200	0.2597699	0.200	0.2765134	-0.100	0.0221225	0.100	0.1603772
-0.250	0.0841217	0.250	0.1079366	-0.150	0.0040808	0.150	0.0993881
-0.300	0.0323297	0.300	0.0485525	-0.200	0.0009139	0.200	0.0641806
-0.350	0.0139007	0.350	0.0239620	-0.250	0.0002106	0.250	0.0413184
-0.400	0.0064552	0.400	0.0126001			0.300	0.0260014
-0.450	0.0031648	0.450	0.0069272			0.350	0.0158270
-0.500	0.0016130	0.500	0.0039306			0.400	0.0092603
-0.550	0.0008451	0.550	0.0022808			0.450	0.0051871
-0.600	0.0004515	0.600	0.0013443			0.500	0.0027739
-0.650	0.0002445	0.650	0.0008007			0.550	0.0014134
-0.700	0.0001335	0.700	0.0004799			0.600	0.0006852
-0.750	0.7324E-04	0.750	0.0002886			0.650	0.0003157
-0.800	0.4024E-04	0.800	0.0001737				
		0.850	0.0001044				

NOTE: for curve fits x = |x|

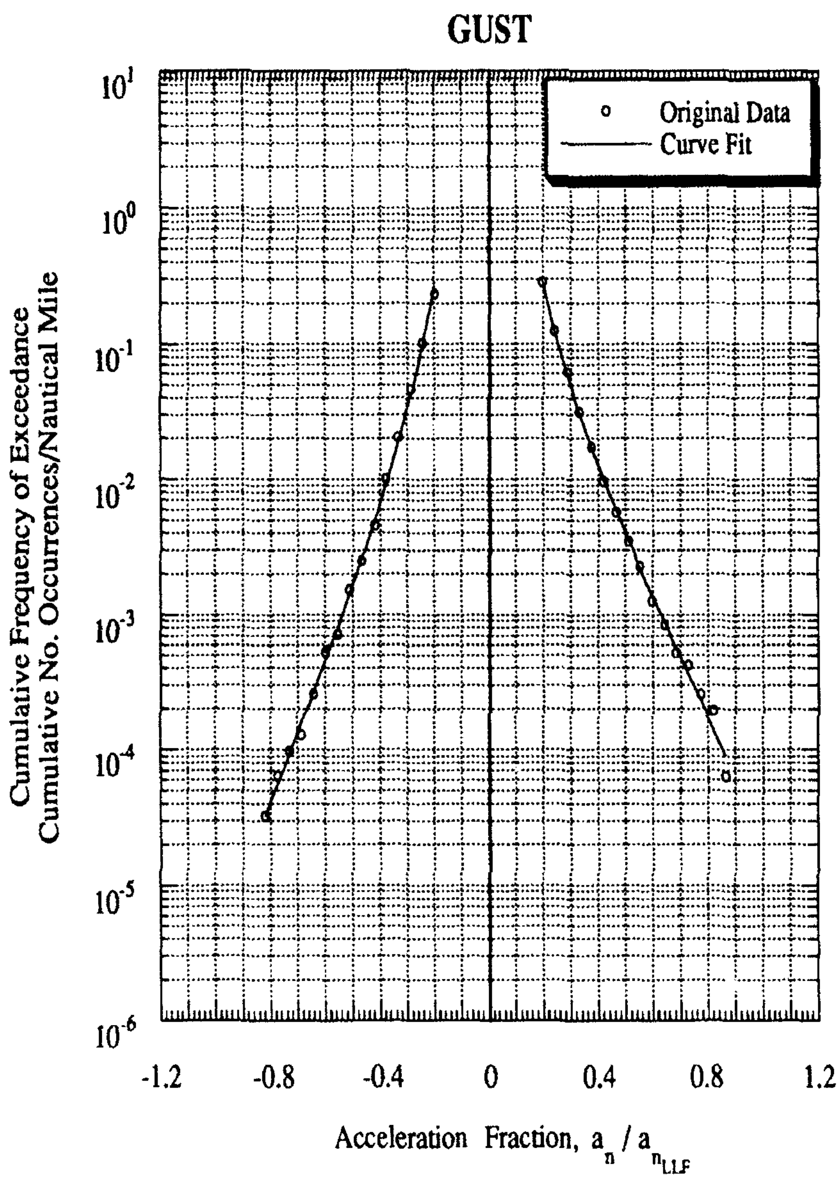
Curve fit original data (-0.800 < x < -0.199)
$\log(y) = -3.780 - 1.668x^2 - 4.666\log(x)$
Curve fit for extrapolation (-1.650<x<-0.800)
$\log(y) = -0.234 - 5.202x$

Curve fit original data (0.199 < x < 0.850)
$\log(y) = -3.213 - 1.442x^2 - 3.881\log(x)$
Curve fit for extrapolation (0.850<x< 1.600)
$\log(y) = -0.212 - 4.435x$

Curve fit original data (-0.250 < x < -0.113)
$\log(y) = -4.613 - 14.947x^2 - 3.108\log(x)$
Curve fit for extrapolation (-0.813<x<-0.250)
$\log(y) = -0.459 - 12.872x$

Curve fit original data (0.090 < x < 0.650)
$\log(y) = -1.576 - 4.923x^2 - 0.831\log(x)$
Curve fit for extrapolation (0.650<x< 1.500)
$\log(y) = 1.020 - 6.954x$

Figure C-38 Load Spectra for Airplane 27, Single-Engine, Special Usage



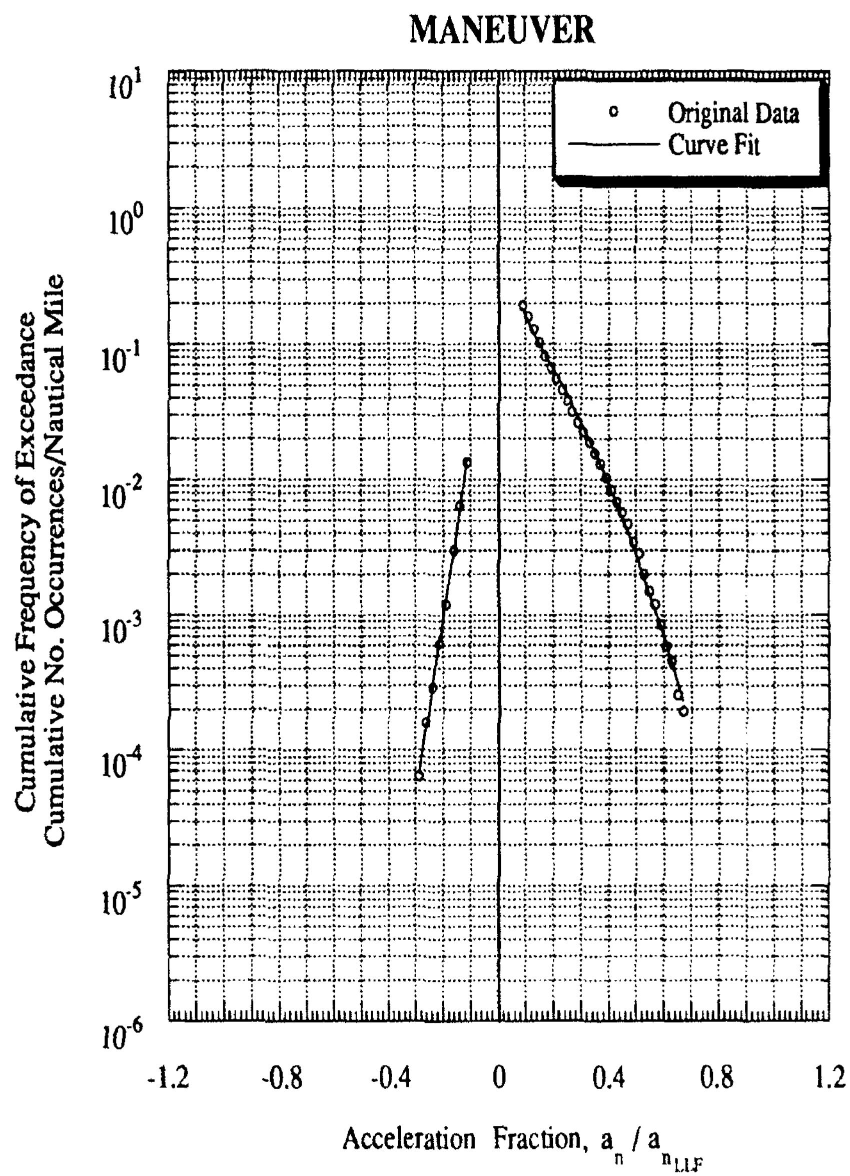


Table C-39 Tabulated Data for Airplane 29

Total Nautical Miles = 39219 Total Hours = 339

GUST negative		GUST positive		MANEUVER negative		MANEUVER positive	
Acceleration Fraction	Cumulative Frequency of Exceedance	Acceleration Fraction	Cumulative Frequency of Exceedance	Acceleration Fraction	Cumulative Frequency of Exceedance	Acceleration Fraction	Cumulative Frequency of Exceedance
-0.200	0.0094866	0.200	0.0456167	-0.200	0.2776887	0.150	2.1444571
-0.250	0.0039202	0.250	0.0185266	-0.250	0.1180137	0.200	1.6829550
-0.300	0.0014019	0.300	0.0080676	-0.300	0.0414690	0.250	1.2324160
-0.350	0.0004307	0.350	0.0036271	-0.350	0.0120484	0.300	0.8421170
-0.400	0.0001132	0.400	0.0016461	-0.400	0.0028944	0.350	0.5369296
-0.450	0.2538E-04	0.450	0.0007432	-0.450	0.0005749	0.400	0.3194422
		0.500	0.0003305			0.450	0.1773362
		0.550	0.0001438			0.500	0.0918612
		0.600	0.6086E-04			0.550	0.0444015
		0.650	0.2496E-04			0.600	0.0200259
		0.700	0.1007E-04			0.650	0.0084279
						0.700	0.0033096
						0.750	0.0012127
						0.800	0.0004146
						0.850	0.0001323
						0.900	0.3938E-04

NOTE: for curve fits x = |x|

Curve fit original data (-0.450 < x < -0.217)
$\log(y) = -1.840 - 14.590x^2 - 0.573\log(x)$
Curve fit for extrapolation (-1.200 < x < -0.450)
$\log(y) = 1.562 - 13.684x$

Curve fit original data (0.217 < x < 0.650)
$\log(y) = -3.247 - 4.532x^2 - 2.986\log(x)$
Curve fit for extrapolation (0.650 < x < 1.400)
$\log(y) = 0.523 - 7.886x$

Curve fit original data (-0.450 < x < -0.179)
$\log(y) = 0.104 - 16.517x^2$
Curve fit for extrapolation (-0.900 < x < -0.450)
$\log(y) = 0.104 - 16.517x^2$

Curve fit original data (0.161 < x < 0.900)
$\log(y) = 0.467 - 6.014x^2$
Curve fit for extrapolation (0.900 < x < 1.600)
$\log(y) = 0.467 - 6.014x^2$

Figure C-39 Load Spectra for Airplane 29, Aerial Application

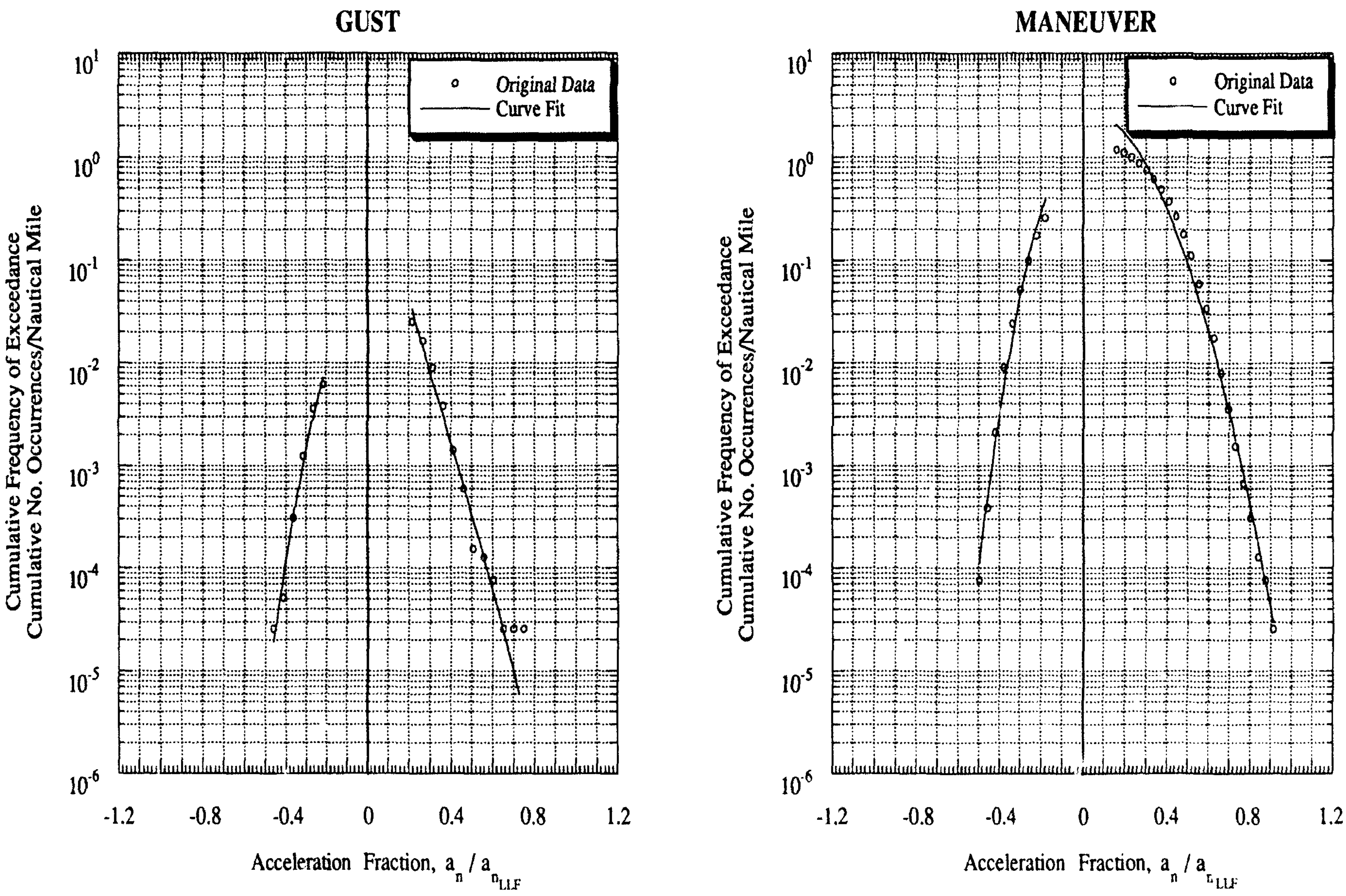


Table C-40 Tabulated Data for Airplane 29[1]

Total Nautical Miles = 30818   Total Hours = 298

GUST				MANEUVER			
negative		positive		negative		positive	
Acceleration Fraction	Cumulative Frequency of Exceedance	Acceleration Fraction	Cumulative Frequency of Exceedance	Acceleration Fraction	Cumulative Frequency of Exceedance	Acceleration Fraction	Cumulative Frequency of Exceedance
-0.200	0.0074142	0.200	0.0253440	-0.200	0.1417121	0.150	1.2101810
-0.250	0.0059515	0.250	0.0215620	-0.250	0.0575218	0.200	1.0609890
-0.300	0.0031128	0.300	0.0140027	-0.300	0.0165183	0.250	0.8395134
-0.350	0.0011187	0.350	0.0071725	-0.350	0.0034250	0.300	0.6058450
-0.400	0.0002852	0.400	0.0029551	-0.400	0.0005190	0.350	0.4010009
		0.450	0.0009917	-0.450	0.5794E-04	0.400	0.2442483
						0.450	0.1372008
						0.500	0.0711804
						0.550	0.0341428
						0.600	0.0151534
						0.650	0.0062265
						0.700	0.0023698
						0.750	0.0008357
						0.800	0.0002732
						0.850	0.8277E-04
						0.900	0.2326E-04

NOTE: for curve fits x = |x|

Curve fit original data ($-0.400 < x < -0.217$)
$\log(y) = 1.697 - 22.322x^2 + 4.198\log(x)$
Curve fit for extrapolation ($-1.200 < x < -0.400$)
$\log(y) = 1.775 - 13.300x$

Curve fit original data ($0.217 < x < 0.450$)
$\log(y) = 0.785 - 14.275x^2 + 2.590\log(x)$
Curve fit for extrapolation ($0.450 < x < 1.400$)
$\log(y) = 1.653 - 10.348x$

Curve fit original data ($-0.450 < x < -0.179$)
$\log(y) = 1.252 - 24.344x^2 + 1.612\log(x)$
Curve fit for extrapolation ($-0.900 < x < -0.450$)
$\log(y) = 4.923 - 20.355x$

Curve fit original data ($0.161 < x < 0.900$)
$\log(y) = 0.592 - 6.426x^2 + 0.443\log(x)$
Curve fit for extrapolation ($0.900 < x < 1.600$)
$\log(y) = 5.585 - 11.354x$

Figure C-40 Load Spectra for Airplane 29[1], Aerial Application

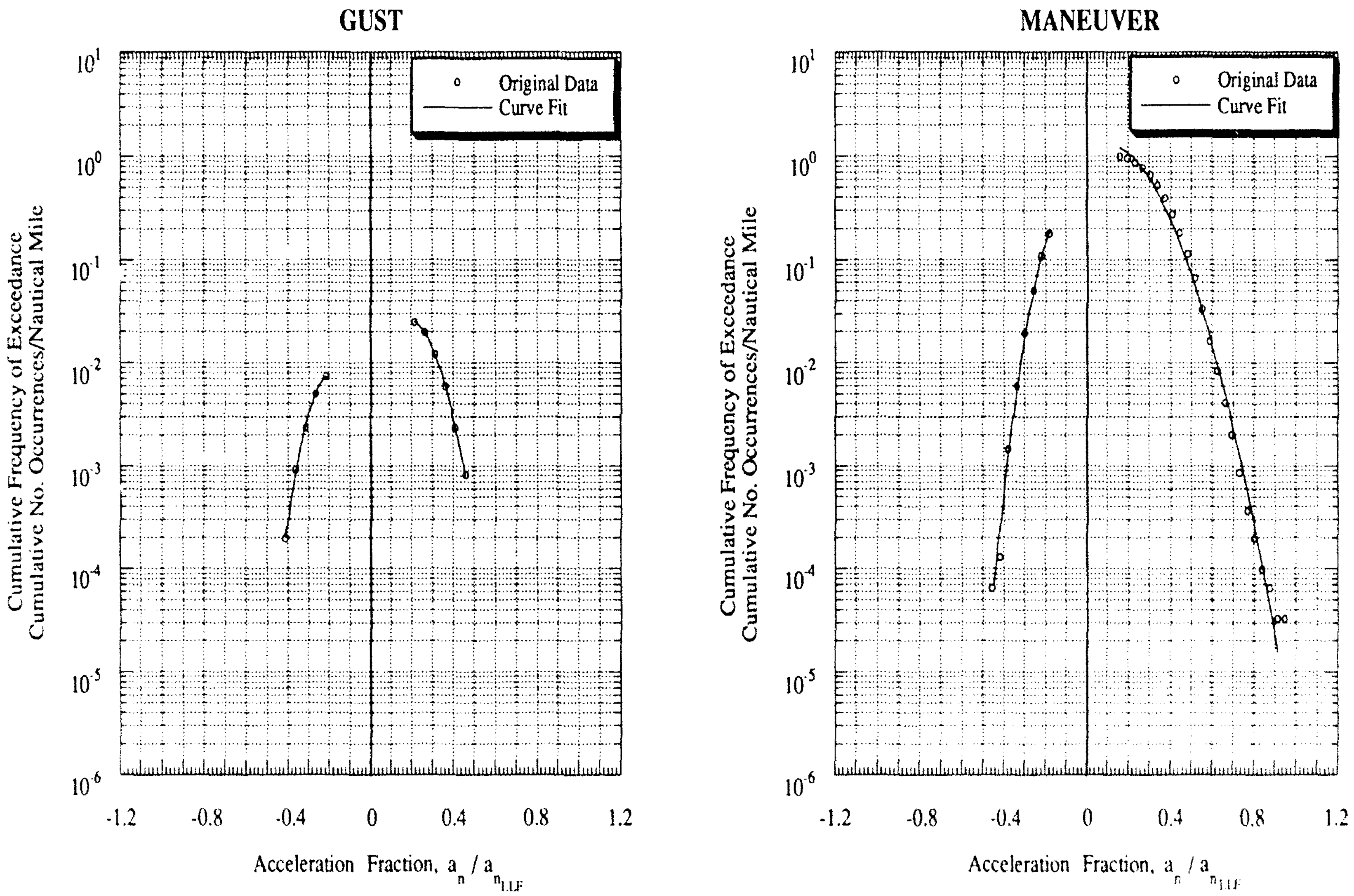


Table C-41 Tabulated Data for Airplane 30

Total Nautical Miles = 22835 Total Hours = 248

GUST negative Acceleration Fraction	GUST negative Cumulative Frequency of Exceedance	GUST positive Acceleration Fraction	GUST positive Cumulative Frequency of Exceedance	MANEUVER negative Acceleration Fraction	MANEUVER negative Cumulative Frequency of Exceedance	MANEUVER positive Acceleration Fraction	MANEUVER positive Cumulative Frequency of Exceedance
-0.250	0.0023976	0.250	0.0137767	-0.150	0.2701153	0.150	1.4935420
-0.300	0.0009783	0.300	0.0076990	-0.200	0.1025698	0.200	0.8671626
-0.350	0.0003391	0.350	0.0039435	-0.250	0.0231514	0.250	0.4947989
-0.400	0.9987E-04	0.400	0.0018471	-0.300	0.0032308	0.300	0.2713435
		0.450	0.0007900			0.350	0.1413211
		0.500	0.0003082			0.400	0.0694079
		0.550	0.0001096			0.450	0.0319990
						0.500	0.0138049
						0.550	0.0055607
						0.600	0.0020879
						0.650	0.0007298
						0.700	0.0002373
						0.750	0.7169E-04

NOTE: for curve fits x = |x|

Gust negative
Curve fit original data ($-0.400 < x < -0.253$)
$\log(y) = -1.735 - 14.157x^2$
Curve fit for extrapolation ($-1.200 < x < -0.400$)
$\log(y) = -1.735 - 14.157x^2$

Gust positive
Curve fit original data ($0.253 < x < 0.550$)
$\log(y) = -1.525 - 8.313x^2 - 0.304\log(x)$
Curve fit for extrapolation ($0.550 < x < 1.400$)
$\log(y) = 1.201 - 9.384x$

Maneuver negative
Curve fit original data ($-0.300 < x < -0.155$)
$\log(y) = 1.606 - 35.879x^2 + 1.660\log(x)$
Curve fit for extrapolation ($-0.900 < x < -0.300$)
$\log(y) = 3.247 - 19.125x$

Maneuver positive
Curve fit original data ($0.161 < x < 0.750$)
$\log(y) = -0.448 - 6.781x^2 - 0.940\log(x)$
Curve fit for extrapolation ($0.750 < x < 1.600$)
$\log(y) = 3.892 - 10.716x$

Figure C-41 Load Spectra for Airplane 30, Aerial Application

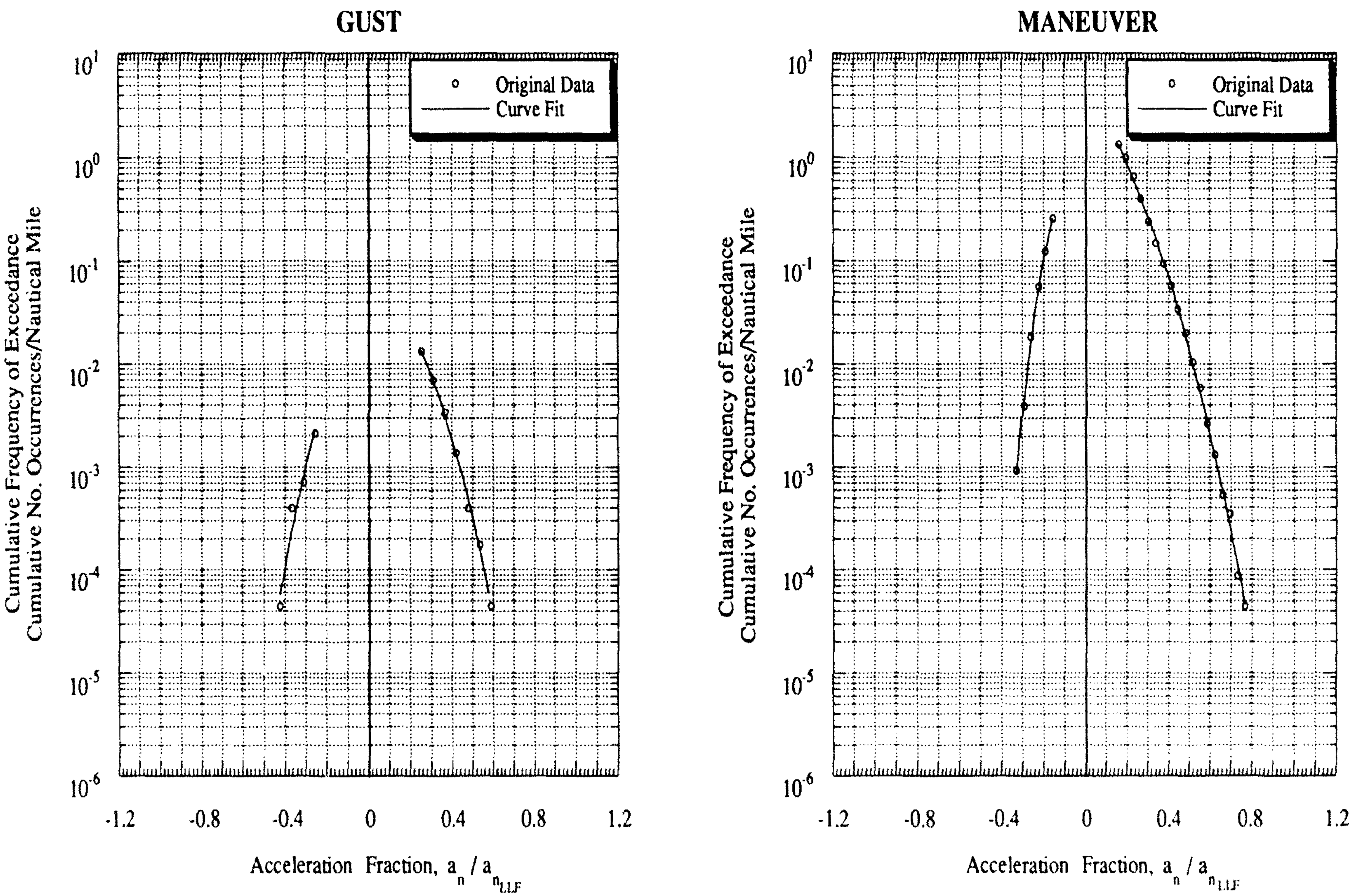


Table C-42 Tabulated Data for Airplane 30[1]

Total Nautical Miles = 4437 Total Hours = 47

GUST				MANEUVER			
negative		positive		negative		positive	
Acceleration Fraction	Cumulative Frequency of Exceedance	Acceleration Fraction	Cumulative Frequency of Exceedance	Acceleration Fraction	Cumulative Frequency of Exceedance	Acceleration Fraction	Cumulative Frequency of Exceedance
-0.250	0.0029882	0.250	0.0111754	-0.150	0.1214501	0.150	0.7829325
-0.300	0.0021519	0.300	0.0039196	-0.200	0.0464118	0.200	0.5645016
		0.350	0.0011363	-0.250	0.0134740	0.250	0.3547994
				-0.300	0.0029717	0.300	0.1957734
				-0.350	0.0004979	0.350	0.0951961
						0.400	0.0408845
						0.450	0.0155312
						0.500	0.0052238
						0.550	0.0015567

NOTE: for curve fits x = |x|

Curve fit original data ($-0.300 < x < -0.253$)
$\log(y) = -1.812 - 2.852x$
Curve fit for extrapolation ($-1.200 < x < -0.300$)
$\log(y) = -1.812 - 2.852x$

Curve fit original data ($0.253 < x < 0.350$)
$\log(y) = -0.918 - 16.546x^2$
Curve fit for extrapolation ($0.350 < x < 1.400$)
$\log(y) = -0.918 - 16.546x^2$

Curve fit original data ($-0.350 < x < -0.155$)
$\log(y) = -0.378 - 23.873x^2$
Curve fit for extrapolation ($-0.900 < x < -0.350$)
$\log(y) = -0.378 - 23.873x^2$

Curve fit original data ($0.161 < x < 0.550$)
$\log(y) = 0.370 - 10.250x^2 + 0.299\log(x)$
Curve fit for extrapolation ($0.550 < x < 1.600$)
$\log(y) = 3.264 - 11.039x$

Figure C-42 Load Spectra for Airplane 30[1], Aerial Application

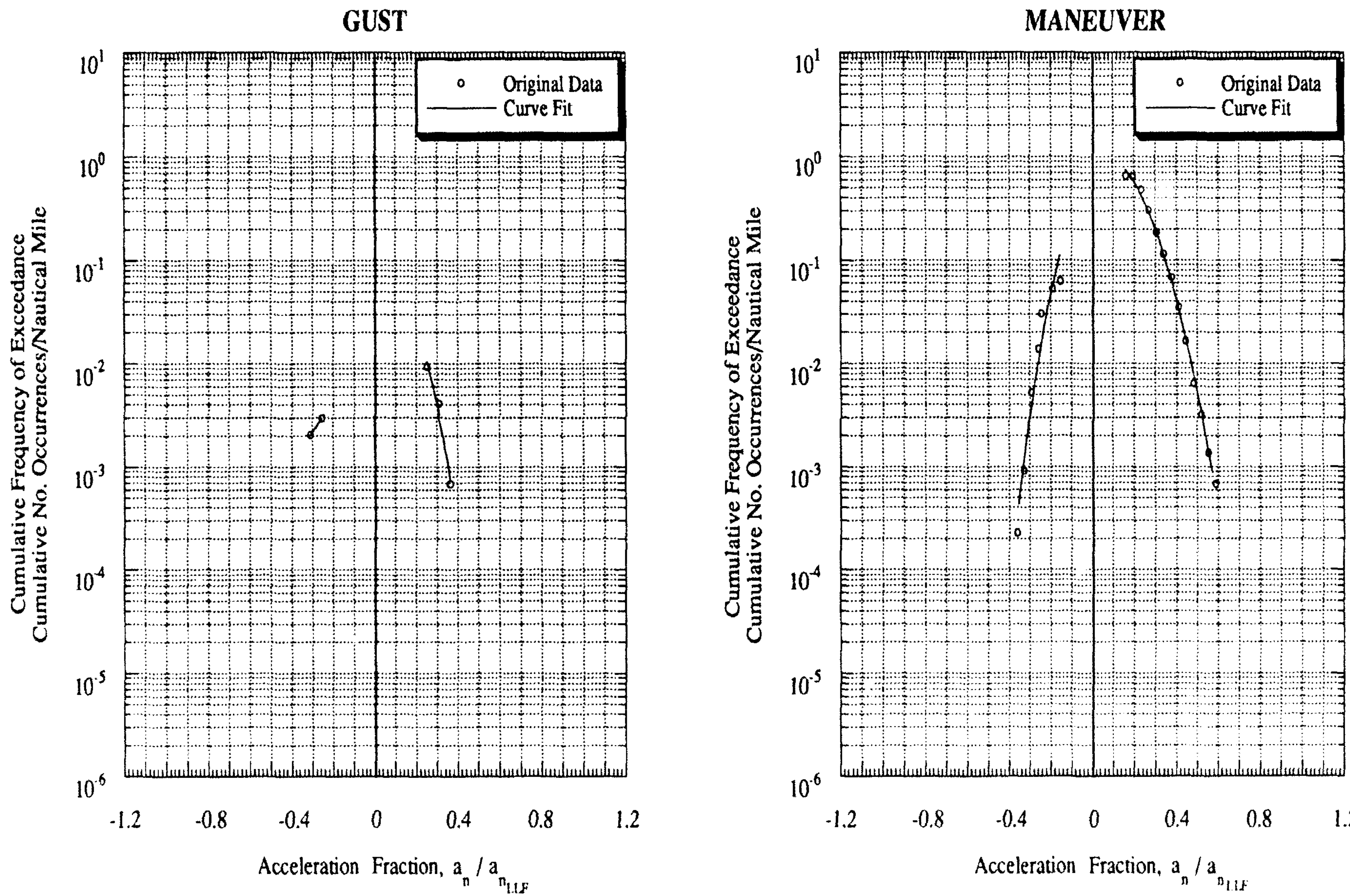


Table C-43 Tabulated Data for Airplane 30[2]

Total Nautical Miles = 12459 Total Hours = 140

GUST negative Acceleration Fraction	GUST negative Cumulative Frequency of Exceedance	GUST positive Acceleration Fraction	GUST positive Cumulative Frequency of Exceedance	MANEUVER negative Acceleration Fraction	MANEUVER negative Cumulative Frequency of Exceedance	MANEUVER positive Acceleration Fraction	MANEUVER positive Cumulative Frequency of Exceedance
-0.250	0.0036681	0.250	0.0058871	-0.150	0.2546294	0.150	1.7832750
-0.300	0.0006487	0.300	0.0011195	-0.200	0.0910308	0.200	0.5544180
-0.350	0.0001286	0.350	0.0001546	-0.250	0.0238235	0.250	0.2158168
		0.400	0.1822E-04	-0.300	0.0059386	0.300	0.0961062
		0.450	0.2147E-05	-0.350	0.0016226	0.350	0.0466573
				-0.400	0.0005284	0.400	0.0239941
						0.450	0.0128308
						0.500	0.0070448
						0.550	0.0039357
						0.600	0.0022225
						0.650	0.0012621
						0.700	0.0007179
						0.750	0.0004078
						0.800	0.0002307
						0.850	0.0001298
						0.900	0.7273E-04
						0.950	0.4076E-04
						1.000	0.2284E-04
						1.050	0.1280E-04
						1.100	0.7174E-05
						1.150	0.4020E-05

NOTE: for curve fits x = |x|

Gust negative:
Curve fit original data ($-0.350 < x < -0.253$)
$\log(y) = -6.202 - 7.197x^2 - 7.003\log(x)$
Curve fit for extrapolation ($-1.200 < x < -0.350$)
$\log(y) = 0.914 - 13.727x$

Gust positive:
Curve fit original data ($0.253 < x < 0.350$)
$\log(y) = -0.364 - 27.053x^2 + 0.292\log(x)$
Curve fit for extrapolation ($0.350 < x < 1.400$)
$\log(y) = 2.691 - 18.575x$

Maneuver negative:
Curve fit original data ($-0.400 < x < -0.155$)
$\log(y) = 15.11 - 48.97x + 35.13x^2 + 11.10\log(x)$
Curve fit for extrapolation ($-0.900 < x < -0.400$)
$\log(y) = 0.247 - 8.810x$

Maneuver positive:
Curve fit original data ($0.161 < x < 0.850$)
$\log(y) = -2.844 - 1.815x^2 - 3.807\log(x)$
Curve fit for extrapolation ($0.850 < x < 1.600$)
$\log(y) = 0.389 - 5.030x$

Figure C-43 Load Spectra for Airplane 30², Aerial Application

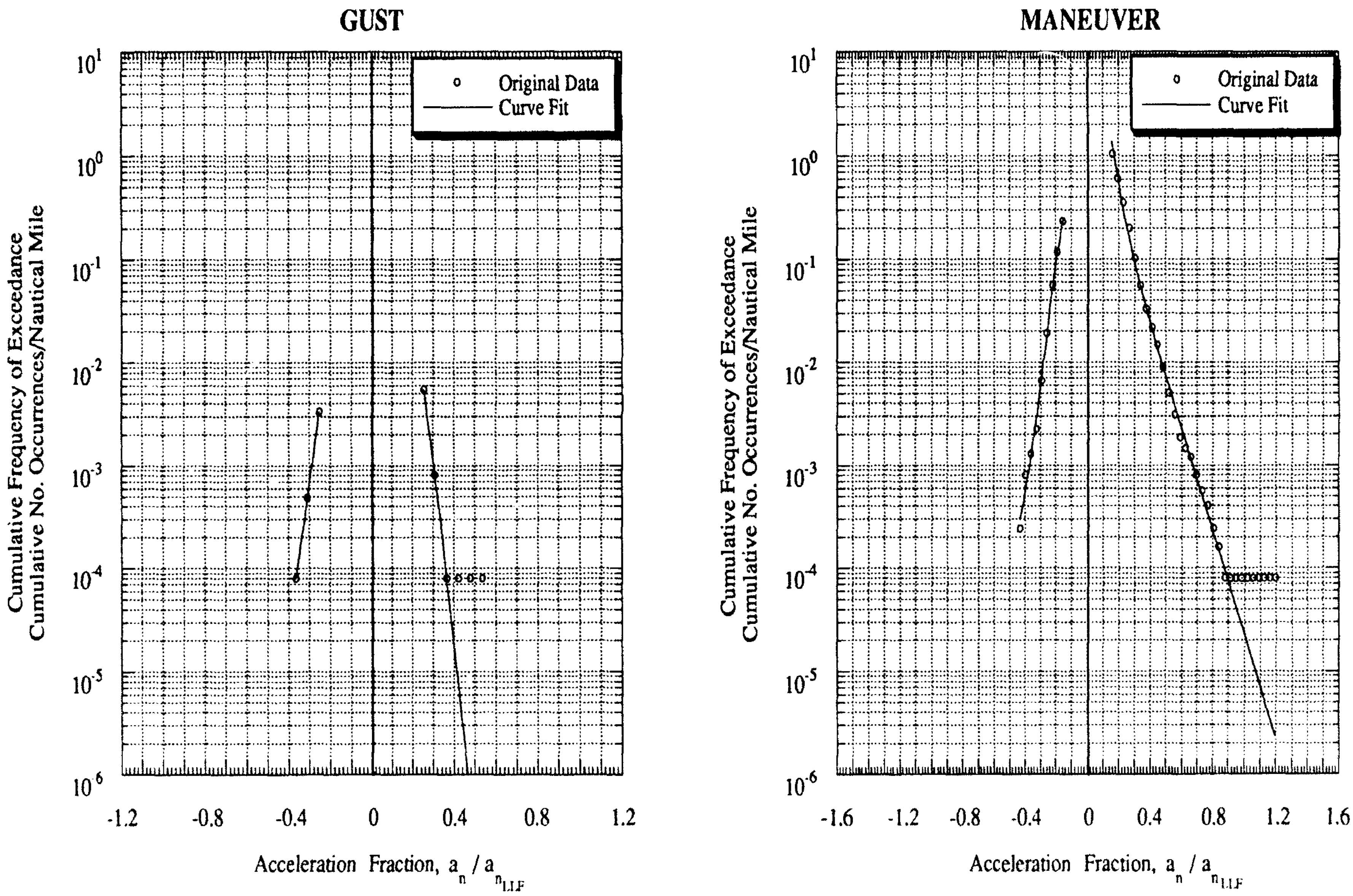


Table C-44 Tabulated Data for Airplane 30A

Total Nautical Miles = 72228 Total Hours = 830

GUST negative Acceleration Fraction	Cumulative Frequency of Exceedance	GUST positive Acceleration Fraction	Cumulative Frequency of Exceedance	MANEUVER negative Acceleration Fraction	Cumulative Frequency of Exceedance	MANEUVER positive Acceleration Fraction	Cumulative Frequency of Exceedance
-0.250	0.0018866	0.250	0.0020481	-0.150	0.5325209	0.150	1.6802011
-0.300	0.0006326	0.300	0.0004791	-0.200	0.4096847	0.200	1.5169400
-0.350	0.0002521	0.350	0.0001142	-0.250	0.2837612	0.250	1.2317330
-0.400	0.0001142	0.400	0.2678E-04	-0.300	0.1452327	0.300	0.9107518
-0.450	0.5698E-04			-0.350	0.0450818	0.350	0.6173005
-0.500	0.2965E-04			-0.400	0.0069660	0.400	0.3850560
				-0.450	0.0004398	0.450	0.2216102
						0.500	0.1178829
						0.550	0.0580292
						0.600	0.0264591
						0.650	0.0111825
						0.700	0.0043830
						0.750	0.0015939
						0.800	0.0005380
						0.850	0.0001686
						0.900	0.4905E-04

NOTE: for curve fits $x = |x|$

Curve fit original data ($-0.450 < x < -0.253$)
$\log(y) = -6.386 + 0.196x^2 - 6.062\log(x)$
Curve fit for extrapolation ($-1.200 < x < -0.450$)
$\log(y) = -1.691 - 5.674x$

Curve fit original data ($0.253 < x < 0.400$)
$\log(y) = -4.860 - 9.667x^2 - 4.610\log(x)$
Curve fit for extrapolation ($0.400 < x < 1.400$)
$\log(y) = 0.523 - 12.739x$

Curve fit original data ($-0.500 < x < -0.155$)
$\log(y) = 0.652 - 12.524x + 59.504x^2 - 114.376x^3$
Curve fit for extrapolation ($-0.900 < x < -0.500$)
$\log(y) = 0.652 - 12.524x + 59.504x^2 - 114.376x^3$

Curve fit original data ($0.161 < x < 0.900$)
$\log(y) = 0.798 - 6.276x^2 + 0.524\log(x)$
Curve fit for extrapolation ($0.900 < x < 1.600$)
$\log(y) = 5.630 - 11.044x$

Figure C-44 Load Spectra for Airplane 30A, Aerial Application

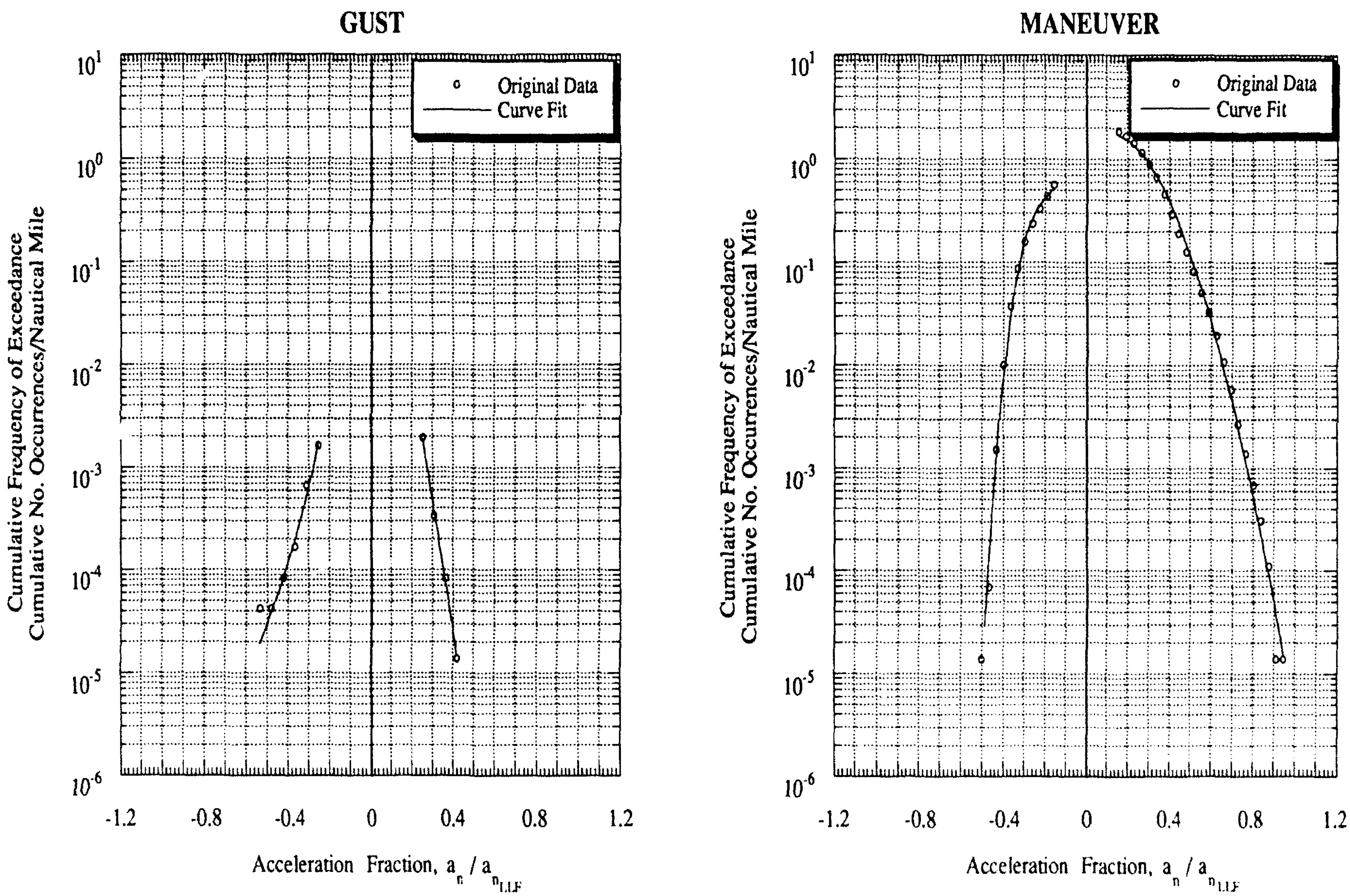


Table C-45 Tabulated Data for Airplane 31

Total Nautical Miles = 47812 Total Hours = 514

GUST negative Acceleration Fraction	GUST negative Cumulative Frequency of Exceedance	GUST positive Acceleration Fraction	GUST positive Cumulative Frequency of Exceedance	MANEUVER negative Acceleration Fraction	MANEUVER negative Cumulative Frequency of Exceedance	MANEUVER positive Acceleration Fraction	MANEUVER positive Cumulative Frequency of Exceedance
-0.300	0.0098601	0.300	0.0096320	-0.150	0.4240738	0.150	2.0983040
-0.350	0.0029318	0.350	0.0021509	-0.200	0.3434145	0.200	1.6714990
-0.400	0.0006841	0.400	0.0006589	-0.250	0.1371435	0.250	1.1860170
-0.450	0.0001261	0.450	0.0002607	-0.300	0.0299850	0.300	0.7557598
		0.500	0.0001279	-0.350	0.0037950	0.350	0.4343953
		0.550	0.7556E-04	-0.400	0.0002875	0.400	0.2258025
		0.600	0.5260E-04			0.450	0.1063276
		0.650	0.3952E-04			0.500	0.0454084
		0.700	0.2969E-04			0.550	0.0176018
		0.750	0.2231E-04			0.600	0.0061968
		0.800	0.1676E-04			0.650	0.0019823
		0.850	0.1259E-04			0.700	0.0005764
		0.900	0.9459E-05			0.750	0.0001524
		0.950	0.7106E-05			0.800	0.3664E-04

NOTE: for curve fits $x = |x|$

Gust negative:
Curve fit original data ($-0.450 < x < -0.298$)
$\log(y) = 0.343 - 18.797x^2 + 1.257\log(x)$
Curve fit for extrapolation ($-1.200 < x < -0.450$)
$\log(y) = 3.167 - 15.704x$

Gust positive:
Curve fit original data ($0.298 < x < 0.600$)
$\log(y) = -8.948 + 5.369x^2 - 12.332\log(x)$
Curve fit for extrapolation ($0.600 < x < 1.400$)
$\log(y) = -2.789 - 2.484x$

Maneuver negative:
Curve fit original data ($-0.400 < x < -0.155$)
$\log(y) = 4.084 - 36.699x^2 + 4.407\log(x)$
Curve fit for extrapolation ($-0.900 < x < -0.400$)
$\log(y) = 6.288 - 24.574x$

Maneuver positive:
Curve fit original data ($0.161 < x < 0.800$)
$\log(y) = 0.789 - 8.112x^2 + 0.346\log(x)$
Curve fit for extrapolation ($0.800 < x < 1.600$)
$\log(y) = 5.797 - 12.792x$

Figure C-45 Load Spectra for Airplane 31, Aerial Application

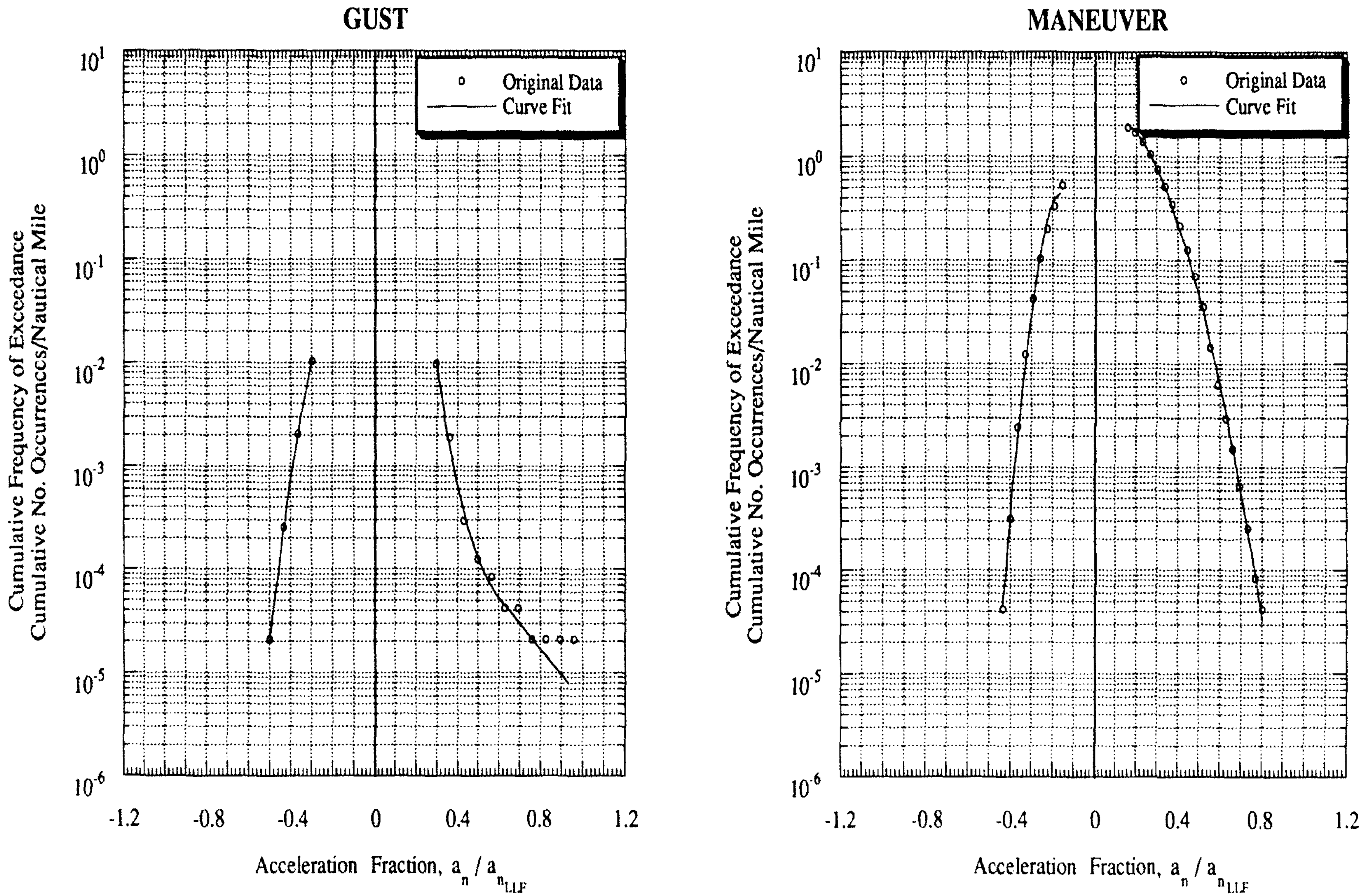


Table C-46 Tabulated Data for Airplane 32

Total Nautical Miles = 9017 **Total Hours = 100**

GUST negative		GUST positive		MANEUVER negative		MANEUVER positive	
Acceleration Fraction	**Cumulative Frequency of Exceedance**	**Acceleration Fraction**	**Cumulative Frequency of Exceedance**	**Acceleration Fraction**	**Cumulative Frequency of Exceedance**	**Acceleration Fraction**	**Cumulative Frequency of Exceedance**
-0.300	0.0049514	0.300	0.0055549	-0.250	0.1251628	0.150	2.0169549
-0.350	0.0016061	0.350	0.0018552	-0.300	0.0413584	0.200	1.5055170
-0.400	0.0005658	0.400	0.0007330	-0.350	0.0112297	0.250	1.0336800
		0.450	0.0003302	-0.400	0.0025040	0.300	0.6528267
		0.500	0.0001654	-0.450	0.0004583	0.350	0.3792458
		0.550	0.8675E-04			0.400	0.2026539
						0.450	0.0996094
						0.500	0.0450357
						0.550	0.0187295
						0.600	0.0071648
						0.650	0.0025211
						0.700	0.0008160

NOTE: for curve fits $x = |x|$

Gust, negative:
Curve fit original data $(-0.400 < x < -0.278)$
$\log(y) = -5.038 - 3.159x^2 - 5.770\log(x)$
Curve fit for extrapolation $(-1.200 < x < -0.400)$
$\log(y) = 0.269 - 8.792x$

Gust, positive:
Curve fit original data $(0.278 < x < 0.500)$
$\log(y) = -6.318 + 0.996x^2 - 7.598\log(x)$
Curve fit for extrapolation $(0.500 < x < 1.400)$
$\log(y) = -0.980 - 5.603x$

Maneuver, negative:
Curve fit original data $(-0.450 < x < -0.225)$
$\log(y) = 0.127 - 17.255x^2 - 0.081\log(x)$
Curve fit for extrapolation $(-0.900 < x < -0.450)$
$\log(y) = 3.684 - 15.607x$

Maneuver, positive:
Curve fit original data $(0.141 < x < 0.700)$
$\log(y) = 0.468 - 7.258x^2$
Curve fit for extrapolation $(0.700 < x < 1.600)$
$\log(y) = 0.468 - 7.258x^2$

Figure C-46 Load Spectra for Airplane 32, Aerial Application

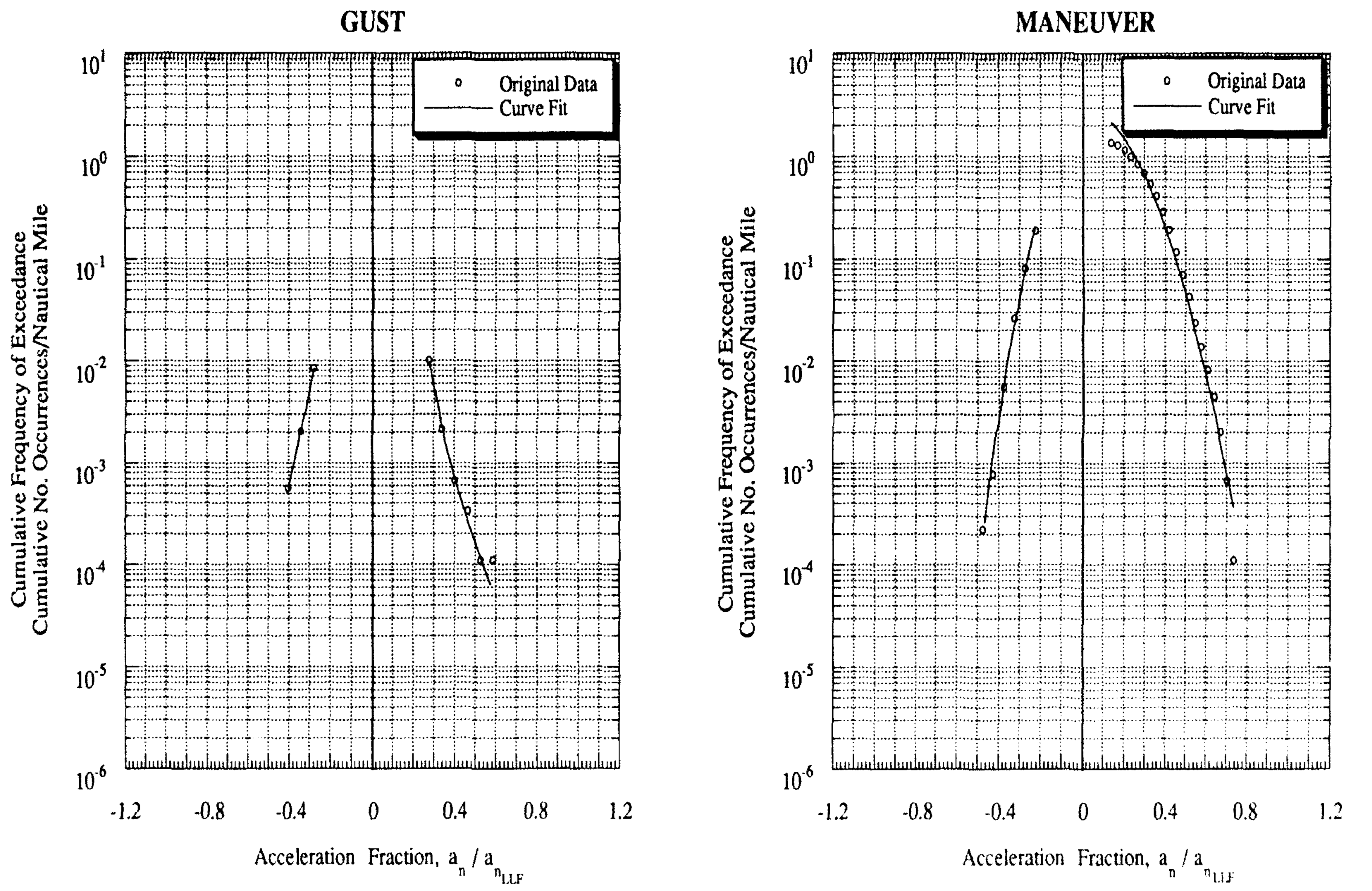


Table C-47 Original Data for Airplane 32[1]

Total Nautical Miles = 36672 Total hours = 380

GUST negative Acceleration Fraction	GUST negative Cumulative Frequency of Exceedance	GUST positive Acceleration Fraction	GUST positive Cumulative Frequency of Exceedance	MANEUVER negative Acceleration Fraction	MANEUVER negative Cumulative Frequency of Exceedance	MANEUVER positive Acceleration Fraction	MANEUVER positive Cumulative Frequency of Exceedance
-0.300	0.0019841	0.300	0.0337713	-0.250	0.1102415	0.150	2.6044500
-0.350	0.0011096	0.350	0.0194318	-0.300	0.0534564	0.200	1.9417551
-0.400	0.0006185	0.400	0.0119938	-0.350	0.0239010	0.250	1.4763750
-0.450	0.0003404	0.450	0.0078068	-0.400	0.0097925	0.300	1.1257859
-0.500	0.0001838	0.500	0.0052967	-0.450	0.0036618	0.350	0.8532876
-0.550	0.9690E-04	0.550	0.0037149	-0.500	0.0012463	0.400	0.6394437
		0.600	0.0026787	-0.550	0.0003853	0.450	0.4721540
		0.650	0.0019726			0.500	0.3427052
		0.700	0.0014811			0.550	0.2441104
		0.750	0.0011300			0.600	0.1704292
		0.800	0.0008738			0.650	0.1165162
		0.850	0.0006837			0.700	0.0779464
		0.900	0.0005404			0.750	0.0509944
		0.950	0.0004309			0.800	0.0326110
		1.000	0.0003462			0.850	0.0203776
		1.050	0.0002801			0.900	0.0124381
		1.100	0.0002280			0.950	0.0074140
		1.150	0.0001865			1.000	0.0043147
		1.200	0.0001533			1.050	0.0024511
		1.250	0.0001265				
		1.300	0.0001046				
		1.350	0.8648E-04				
		1.400	0.7150E-04				
		1.450	0.5911E-04				
		1.500	0.4888E-04				
		1.550	0.4041E-04				
		1.600	0.3341E-04				
		1.650	0.2762E-04				

NOTE: for curve fits $x = |x|$

Curve fit for original data ($-0.550 < x < -0.278$)
$\log(y) = -3.380 - 3.763x^2 - 1.943\log(x)$

Curve fit for original data ($0.278 < x < 1.250$)
$\log(y) = -3.286 - 0.174x^2 - 3.501\log(x)$
Curve fit for extrapolation ($1.250 < x < 1.698$)
$\log(y) = -1.833 - 1.652x$

Curve fit for original data ($-0.550 < x < -0.225$)
$\log(y) = -0.887 - 9.061x^2 - 0.823\log(x)$

Curve fit for original data ($0.141 < x < 1.050$)
$\log(y) = -0.115 - 2.250x^2 - 0.706\log(x)$

Figure C-47 Load Spectra for Airplane 32[1], Aerial Application

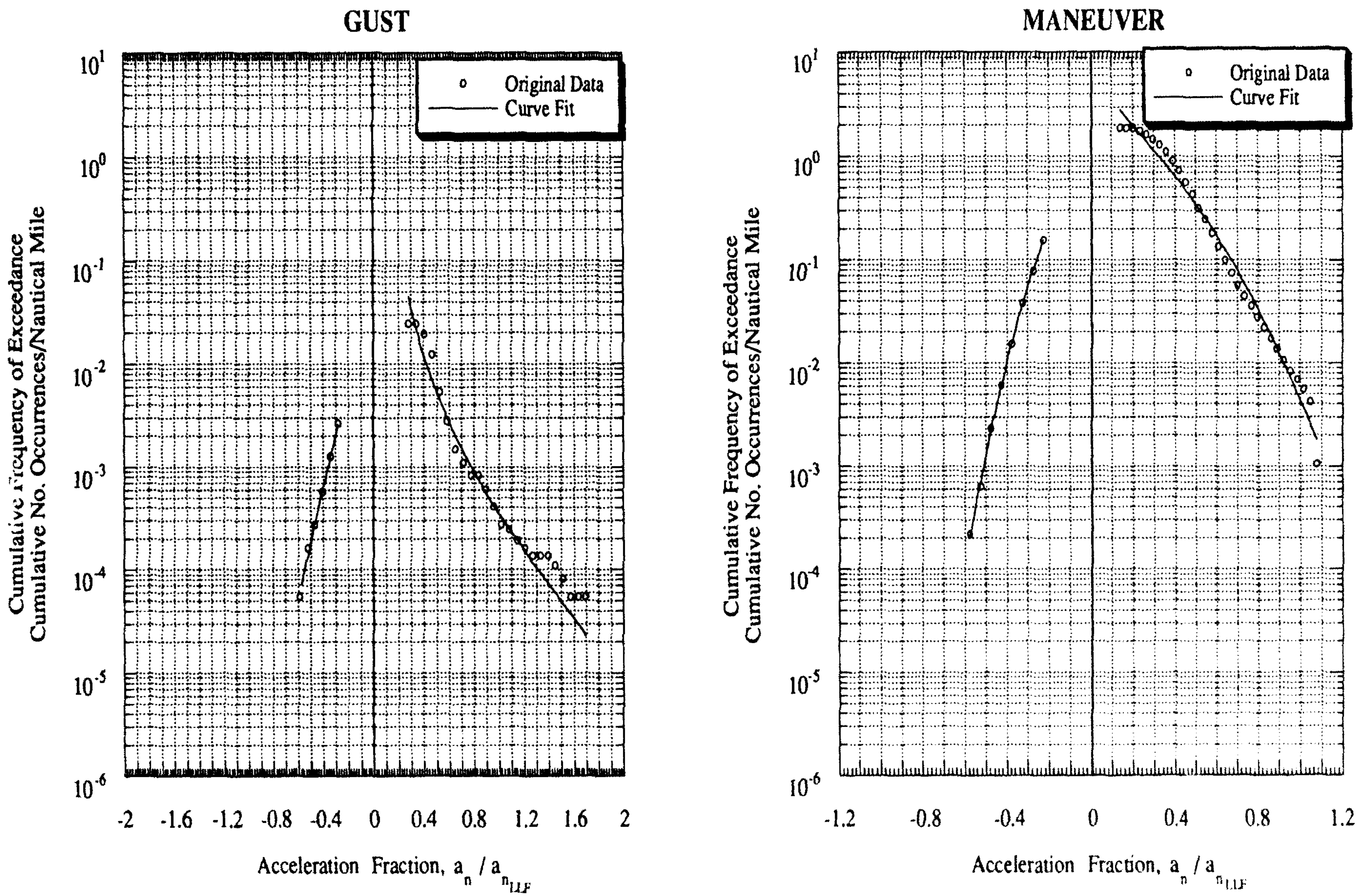


Table C-48 Tabulated Data for Airplane 32[2]

Total Nautical Miles = 17257 Total Hours = 198

GUST				MANEUVER			
negative		positive		negative		positive	
Acceleration Fraction	Cumulative Frequency of Exceedance	Acceleration Fraction	Cumulative Frequency of Exceedance	Acceleration Fraction	Cumulative Frequency of Exceedance	Acceleration Fraction	Cumulative Frequency of Exceedance
-0.300	0.0017923	0.300	0.0009171	-0.250	0.1766829	0.150	1.2046170
-0.350	0.0005424	0.350	0.0004014	-0.300	0.0787225	0.200	1.0322419
-0.400	0.0001366	0.400	0.0002033	-0.350	0.0302808	0.250	0.8377843
		0.450	0.0001155	-0.400	0.0100554	0.300	0.6450821
		0.500	0.7226E-04	-0.450	0.0028827	0.350	0.4716404
		0.550	0.4714E-04	-0.500	0.0007134	0.400	0.3276029
		0.600	0.3076E-04	-0.550	0.0001524	0.450	0.2162579
				-0.600	0.2812E-04	0.500	0.1357013
						0.550	0.0809572
						0.600	0.0459238
						0.650	0.0247727
						0.700	0.0127084
						0.750	0.0062004
						0.800	0.0028772
						0.850	0.0012699
						0.900	0.0005331
						0.950	0.0002129

NOTE: for curve fits $x = |x|$

Curve fit original data $(-0.400 < x < -0.278)$
$\log(y) = -1.309 - 15.973x^2$
Curve fit for extrapolation $(-1.200 < x < -0.400)$
$\log(y) = -1.309 - 15.973x^2$

Curve fit original data $(0.278 < x < 0.500)$
$\log(y) = -6.403 + 1.637x^2 - 6.155\log(x)$
Curve fit for extrapolation $(0.500 < x < 1.400)$
$\log(y) = -2.287 - 3.709x$

Curve fit original data $(-0.600 < x < -0.225)$
$\log(y) = 0.045 - 12.767x^2$
Curve fit for extrapolation $(-0.900 < x < -0.600)$
$\log(y) = 0.045 - 12.767x^2$

Curve fit original data $(0.141 < x < 0.950)$
$\log(y) = 0.235 - 4.328x^2 + 0.069\log(x)$
Curve fit for extrapolation $(0.950 < x < 1.600)$
$\log(y) = 4.109 - 8.191x$

Figure C-48 Load Spectra for Airplane 32^2, Aerial Application

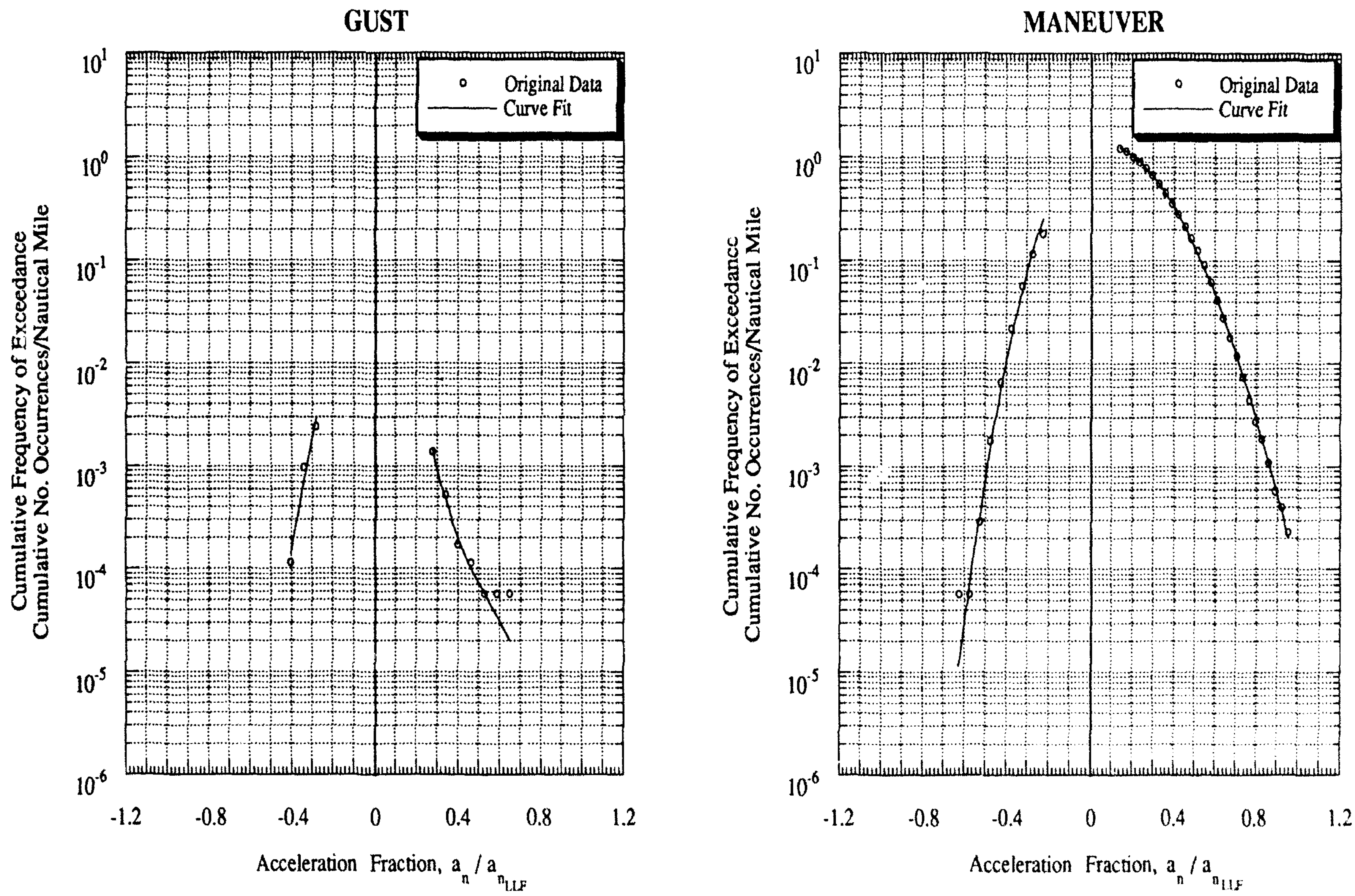


Table C-49 Tabulated Data for Airplane 33

Total Nautical Miles = 55073 Total Hours = 652

GUST negative Acceleration Fraction	GUST negative Cumulative Frequency of Exceedance	GUST positive Acceleration Fraction	GUST positive Cumulative Frequency of Exceedance	MANEUVER negative Acceleration Fraction	MANEUVER negative Cumulative Frequency of Exceedance	MANEUVER positive Acceleration Fraction	MANEUVER positive Cumulative Frequency of Exceedance
-0.300	0.0173835	0.300	0.0631337	-0.250	1.1093690	0.150	1.6318460
-0.350	0.0045097	0.350	0.0203891	-0.300	0.5878060	0.200	1.4720520
-0.400	0.0013086	0.400	0.0073170	-0.350	0.2774847	0.250	1.2475049
-0.450	0.0004100	0.450	0.0028297	-0.400	0.1167054	0.300	0.9985154
-0.500	0.0001355	0.500	0.0011548	-0.450	0.0437310	0.350	0.7570003
-0.550	0.4639E-04	0.550	0.0004900	-0.500	0.0145994	0.400	0.5445079
		0.600	0.0002138	-0.550	0.0043424	0.450	0.3720104
		0.650	0.9509E-04	-0.600	0.0011507	0.500	0.2415871
		0.700	0.4285E-04	-0.650	0.0002717	0.550	0.1492079
		0.750	0.1946E-04	-0.700	0.5715E-04	0.600	0.0876760
		0.800	0.8858E-05			0.650	0.0490309
						0.700	0.0261012
						0.750	0.0132292
						0.800	0.0063849
						0.850	0.0029347
						0.900	0.0012848
						0.950	0.0005358

NOTE: *for curve fits* $x = |x|$

Gust negative:
Curve fit original data ($-0.550 < x < -0.278$)
$\log(y) = -5.243 - 3.182x^2 - 7.208\log(x)$
Curve fit for extrapolation ($-1.200 < x < -0.550$)
$\log(y) = 0.722 - 9.192x$

Gust positive:
Curve fit original data ($0.278 < x < 0.750$)
$\log(y) = -4.303 - 2.124x^2 - 6.301\log(x)$
Curve fit for extrapolation ($0.750 < x < 1.400$)
$\log(y) = 0.416 - 6.835x$

Maneuver negative:
Curve fit original data ($-0.700 < x < -0.225$)
$\log(y) = 0.672 - 10.031x^2$
Curve fit for extrapolation ($-0.900 < x < -0.700$)
$\log(y) = 0.672 - 10.031x^2$

Maneuver positive:
Curve fit original data ($0.141 < x < 0.950$)
$\log(y) = 0.492 - 4.164x^2 + 0.225\log(x)$
Curve fit for extrapolation ($0.950 < x < 1.600$)
$\log(y) = 4.147 - 7.808x$

Figure C-49 Load Spectra for Airplane 33, Aerial Application

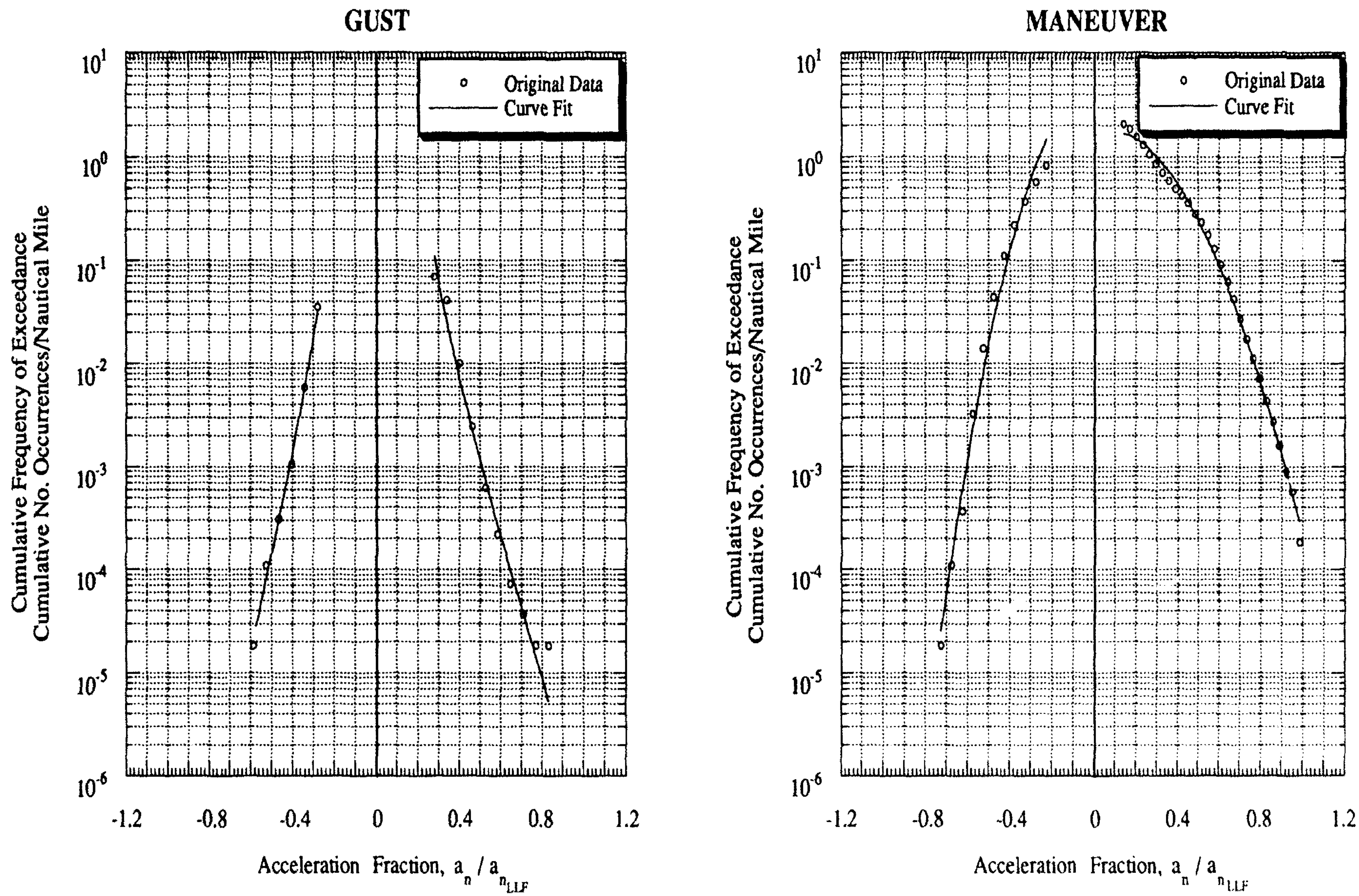


Table C-50 Tabulated Data for Airplane 33[1]

Total Nautical Miles = 10689 Total Hours = 124

GUST negative		GUST positive		MANEUVER negative		MANEUVER positive	
Acceleration Fraction	Cumulative Frequency of Exceedance	Acceleration Fraction	Cumulative Frequency of Exceedance	Acceleration Fraction	Cumulative Frequency of Exceedance	Acceleration Fraction	Cumulative Frequency of Exceedance
-0.300	0.0058720	0.300	0.0058008	-0.250	0.0950349	0.150	1.7124400
-0.350	0.0017613	0.350	0.0022254	-0.300	0.0409951	0.200	0.8349295
-0.400	0.0006072	0.400	0.0009002	-0.350	0.0151771	0.250	0.4175794
-0.450	0.0002322	0.450	0.0003756	-0.400	0.0048223	0.300	0.2063904
		0.500	0.0001592	-0.450	0.0013150	0.350	0.0988242
				-0.500	0.0003078	0.400	0.0453006
						0.450	0.0197282
						0.500	0.0081197
						0.550	0.0031466
						0.600	0.0011450
						0.650	0.0003904
						0.700	0.0001245
						0.750	0.3840E-04

NOTE: for curve fits x = |x|

Curve fit original data ($-0.450 < x < -0.278$)
$\log(y) = -5.967 - 1.014x^2 - 7.319\log(x)$
Curve fit for extrapolation ($-1.200 < x < -0.450$)
$\log(y) = -0.045 - 7.976x$

Curve fit original data ($0.278 < x < 0.500$)
$\log(y) = -4.285 - 3.493x^2 - 4.519\log(x)$
Curve fit for extrapolation ($0.500 < x < 1.400$)
$\log(y) = -0.089 - 7.418x$

Curve fit original data ($-0.500 < x < -0.225$)
$\log(y) = -0.192 - 13.278x^2$
Curve fit for extrapolation ($-0.900 < x < -0.500$)
$\log(y) = -0.192 - 13.278x^2$

Curve fit original data ($0.141 < x < 0.700$)
$\log(y) = -0.913 - 6.602x^2 - 1.572\log(x)$
Curve fit for extrapolation ($0.700 < x < 1.600$)
$\log(y) = 3.248 - 10.219x$

Figure C-50 Load Spectra for Airplane 33[1], Aerial Application

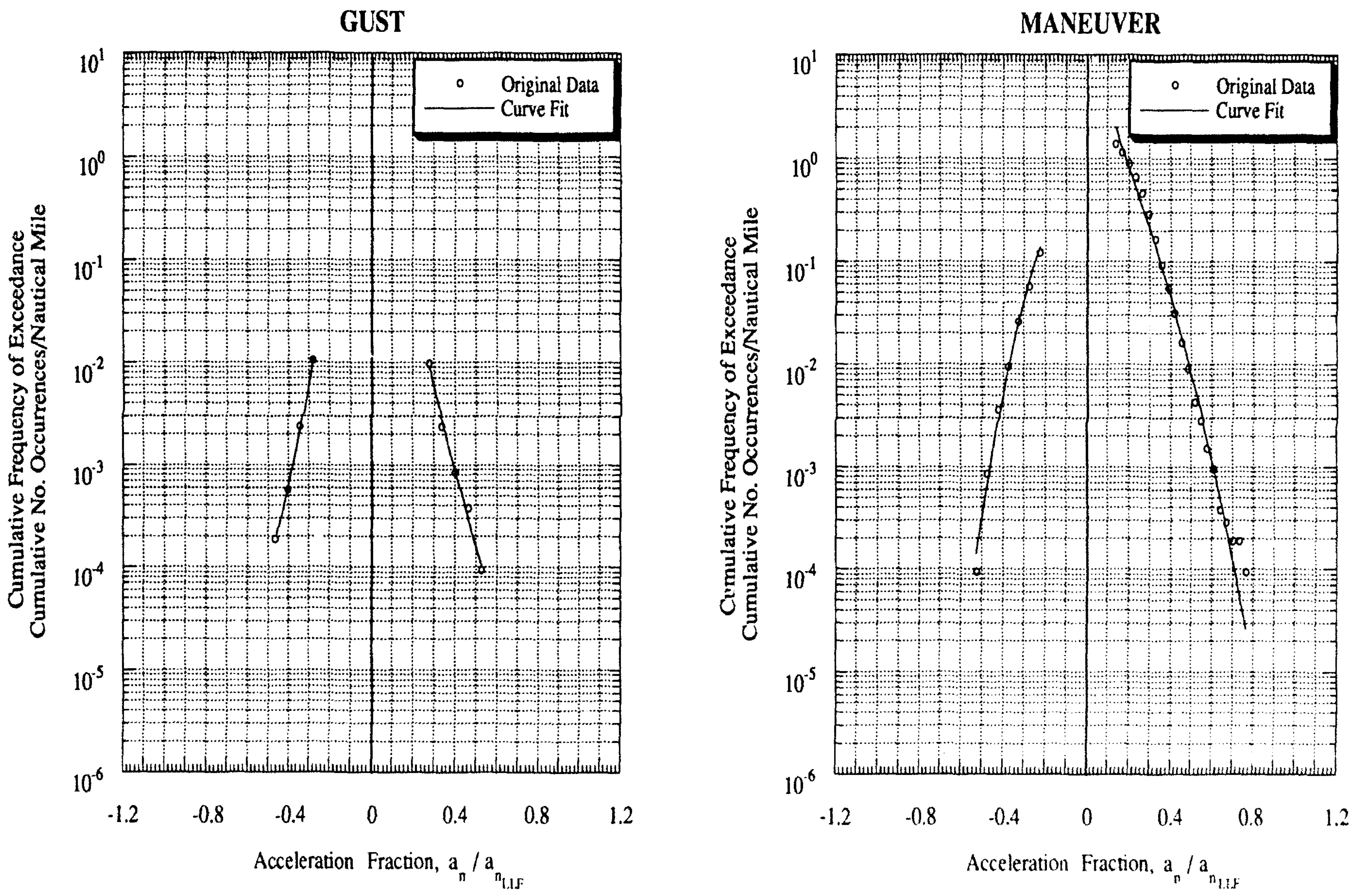


Table C-51 Tabulated Data for Airplane 33A

Total Nautical Miles = 3438 Total Hours = 45

GUST				MANEUVER			
negative		positive		negative		positive	
Acceleration Fraction	Cumulative Frequency of Exceedance	Acceleration Fraction	Cumulative Frequency of Exceedance	Acceleration Fraction	Cumulative Frequency of Exceedance	Acceleration Fraction	Cumulative Frequency of Exceedance
-0.300	0.0005909	0.278	0.0031995	-0.250	0.1185298	0.150	1.2082421
				-0.300	0.0304122	0.200	0.9347926
				-0.350	0.0060933	0.250	0.5344727
						0.300	0.2343520
						0.350	0.0803756
						0.400	0.0218179
						0.450	0.0047232
						0.500	0.0008197

NOTE: for curve fits $x = |x|$

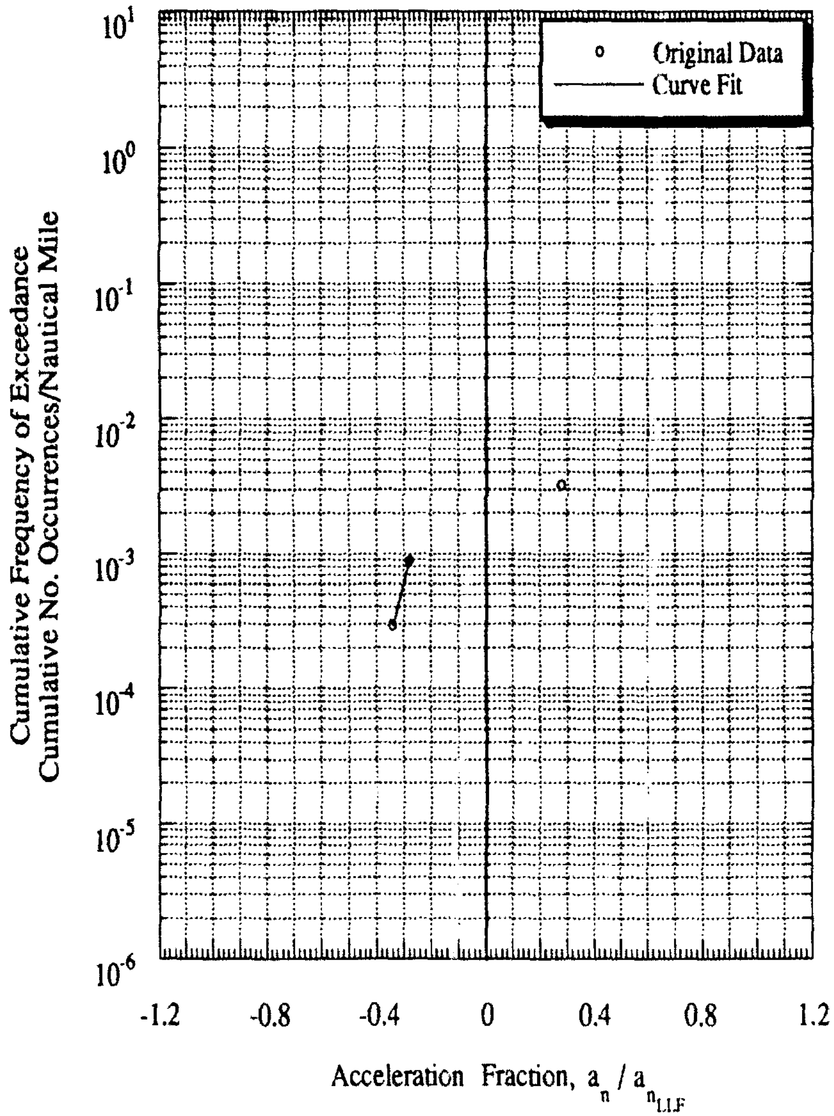
Curve fit original data $(-0.300 < x < -0.278)$
$\log(y) = -0.920 - 7.695x$
Curve fit for extrapolation $(-1.200 < x < -0.300)$
$\log(y) = -0.920 - 7.695x$

Curve fit original data $(-0.350 < x < -0.225)$
$\log(y) = 0.417 - 21.483x^2$
Curve fit for extrapolation $(-0.900 < x < -0.350)$
$\log(y) = 0.417 - 21.483x^2$

Curve fit original data $(0.141 < x < 0.500)$
$\log(y) = 1.763 - 17.517x^2 + 1.562\log(x)$
Curve fit for extrapolation $(0.500 < x < 1.600)$
$\log(y) = 4.994 - 16.160x$

Figure C-51 Load Spectra for Airplane 33A, Aerial Application

GUST



MANEUVER

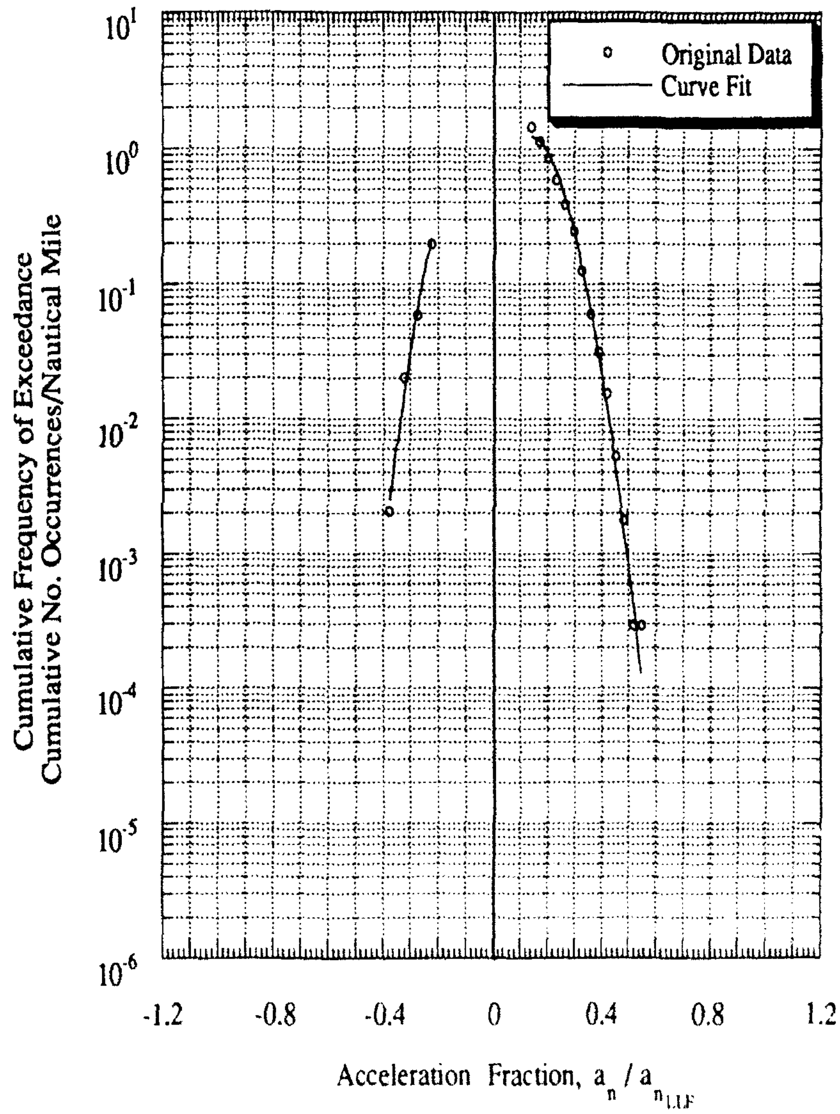


Table C-52 Tabulated Data for Airplane 33A[1]

Total Nautical Miles = 1815　　Total Hours = 23

GUST negative: Acceleration Fraction	GUST negative: Cumulative Frequency of Exceedance	GUST positive: Acceleration Fraction	GUST positive: Cumulative Frequency of Exceedance	MANEUVER negative: Acceleration Fraction	MANEUVER negative: Cumulative Frequency of Exceedance	MANEUVER positive: Acceleration Fraction	MANEUVER positive: Cumulative Frequency of Exceedance
-0.278	0.0005510	0.300	0.0028553	-0.250	0.0704687	0.150	1.2272290
				-0.300	0.0304614	0.200	0.9317526
				-0.350	0.0113052	0.250	0.6692138
				-0.400	0.0036023	0.300	0.4529926
						0.350	0.2884105
						0.400	0.1725071
						0.450	0.0968599
						0.500	0.0510264
						0.550	0.0252114
						0.600	0.0116796
						0.650	0.0050722
						0.700	0.0020646

NOTE: for curve fits x = |x|

Gust positive:
Curve fit original data ($0.278 < x < 0.300$)
$\log(y) = -0.764 - 5.935x$
Curve fit for extrapolation ($0.300 < x < 1.400$)
$\log(y) = -0.764 - 5.935x$

Maneuver negative:
Curve fit original data ($-0.400 < x < -0.225$)
$\log(y) = -0.324 - 13.245x^2$
Curve fit for extrapolation ($-0.900 < x < -0.400$)
$\log(y) = -0.324 - 13.245x^2$

Maneuver positive:
Curve fit original data ($0.141 < x < 0.700$)
$\log(y) = 0.087 - 5.708x^2 - 0.158\log(x)$
Curve fit for extrapolation ($0.700 < x < 1.600$)
$\log(y) = 2.977 - 8.089x$

Figure C-52 Load Spectra for Airplane 33A[1], Aerial Application

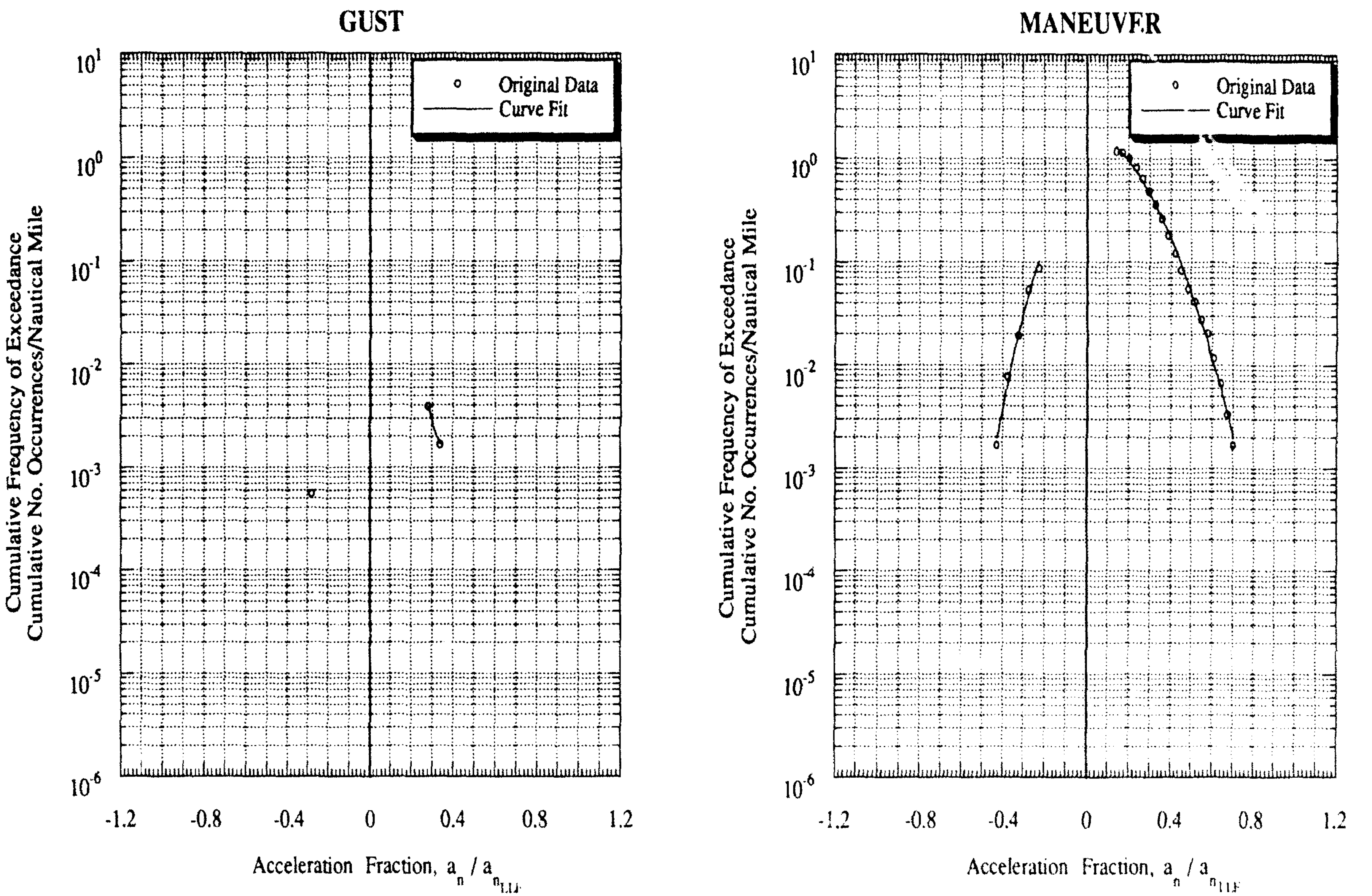


Table C-53 Tabulated Data for Airplane 33A[2]

Total Nautical Miles = 10258 Total Hours = 128

GUST negative		GUST positive		MANEUVER negative		MANEUVER positive	
Acceleration Fraction	Cumulative Frequency of Exceedance	Acceleration Fraction	Cumulative Frequency of Exceedance	Acceleration Fraction	Cumulative Frequency of Exceedance	Acceleration Fraction	Cumulative Frequency of Exceedance
-0.300	0.0142965	0.300	0.0342739	-0.250	0.0866786	0.150	1.8162700
-0.350	0.0053365	0.350	0.0148085	-0.300	0.0527025	0.200	1.2470959
-0.400	0.0022023	0.400	0.0069980	-0.350	0.0282952	0.250	0.8474467
-0.450	0.0009774	0.450	0.0035311	-0.400	0.0134702	0.300	0.5610561
-0.500	0.0004577	0.500	0.0018715	-0.450	0.0057014	0.350	0.3588789
		0.550	0.0010298	-0.500	0.0021495	0.400	0.2206827
		0.600	0.0005832	-0.550	0.0007228	0.450	0.1300374
		0.650	0.0003377			0.500	0.0732644
		0.700	0.0001990			0.550	0.0394058
		0.750	0.0001180			0.600	0.0202101
						0.650	0.0098749
						0.700	0.0045937
						0.750	0.0020334
						0.800	0.0008561
						0.850	0.0003427
						0.900	0.0001337
						0.950	0.5219E-04

NOTE: for curve fits x = |x|

Curve fit original data ($-0.500 < x < -0.278$)
$\log(y) = -4.685 - 1.461x^2 - 5.683\log(x)$
Curve fit for extrapolation ($-1.200 < x < -0.500$)
$\log(y) = -0.141 - 6.398x$

Curve fit original data ($0.278 < x < 0.700$)
$\log(y) = -3.950 - 1.053x^2 - 4.933\log(x)$
Curve fit for extrapolation ($0.700 < x < 1.400$)
$\log(y) = -0.527 - 4.534x$

Curve fit original data ($-0.550 < x < -0.225$)
$\log(y) = -0.138 - 9.452x^2 + 0.554\log(x)$
Curve fit for extrapolation ($-0.900 < x < -0.550$)
$\log(y) = 2.337 - 9.960x$

Curve fit original data ($0.141 < x < 0.850$)
$\log(y) = -0.182 - 4.609x^2 - 0.661\log(x)$
Curve fit for extrapolation ($0.850 < x < 1.600$)
$\log(y) = 3.482 - 8.173x$

Figure C-53 Load Spectra for Airplane $33A^2$, Aerial Application

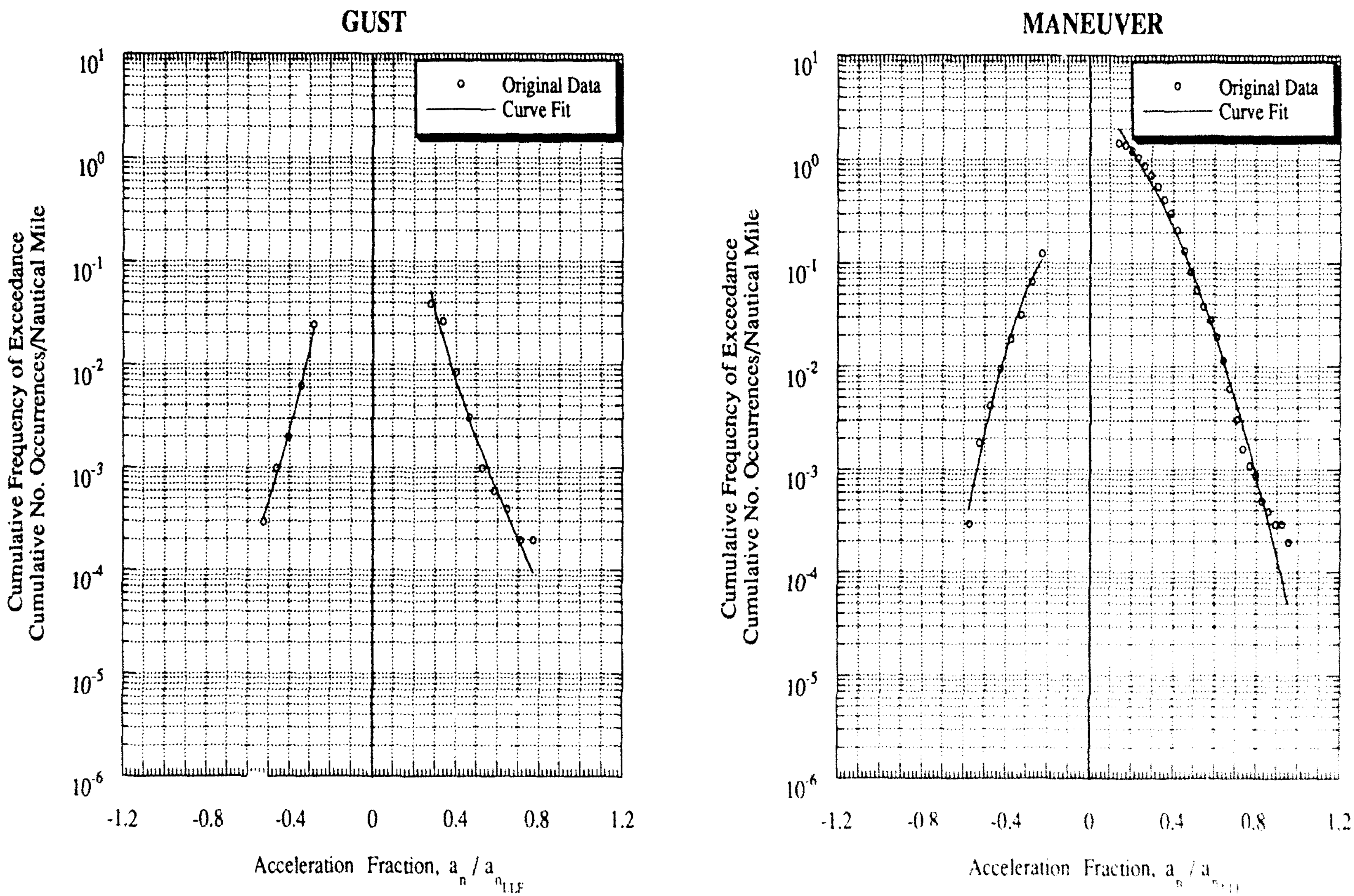


Table C-54 Tabulated Data for Airplane 34

Total Nautical Miles = 2888 Total Hours = 31

GUST negative Acceleration Fraction	GUST negative Cumulative Frequency of Exceedance	GUST positive Acceleration Fraction	GUST positive Cumulative Frequency of Exceedance	MANEUVER negative Acceleration Fraction	MANEUVER negative Cumulative Frequency of Exceedance	MANEUVER positive Acceleration Fraction	MANEUVER positive Cumulative Frequency of Exceedance
-0.250	0.0029095	0.250	0.0051668	-0.200	0.1760291	0.200	0.7013457
-0.300	0.0014409	0.300	0.0020657	-0.250	0.0643248	0.250	0.6104666
-0.350	0.0006514	0.350	0.0007406	-0.300	0.0203724	0.300	0.4984374
		0.400	0.0002508	-0.350	0.0055293	0.350	0.3835231
				-0.400	0.0012775	0.400	0.2788729
						0.450	0.1919686
						0.500	0.1252543
						0.550	0.0775302
						0.600	0.0455558
						0.650	0.0254228
						0.700	0.0134795
						0.750	0.0067924
						0.800	0.0032537
						0.850	0.0014819

NOTE: for curve fits x = |x|

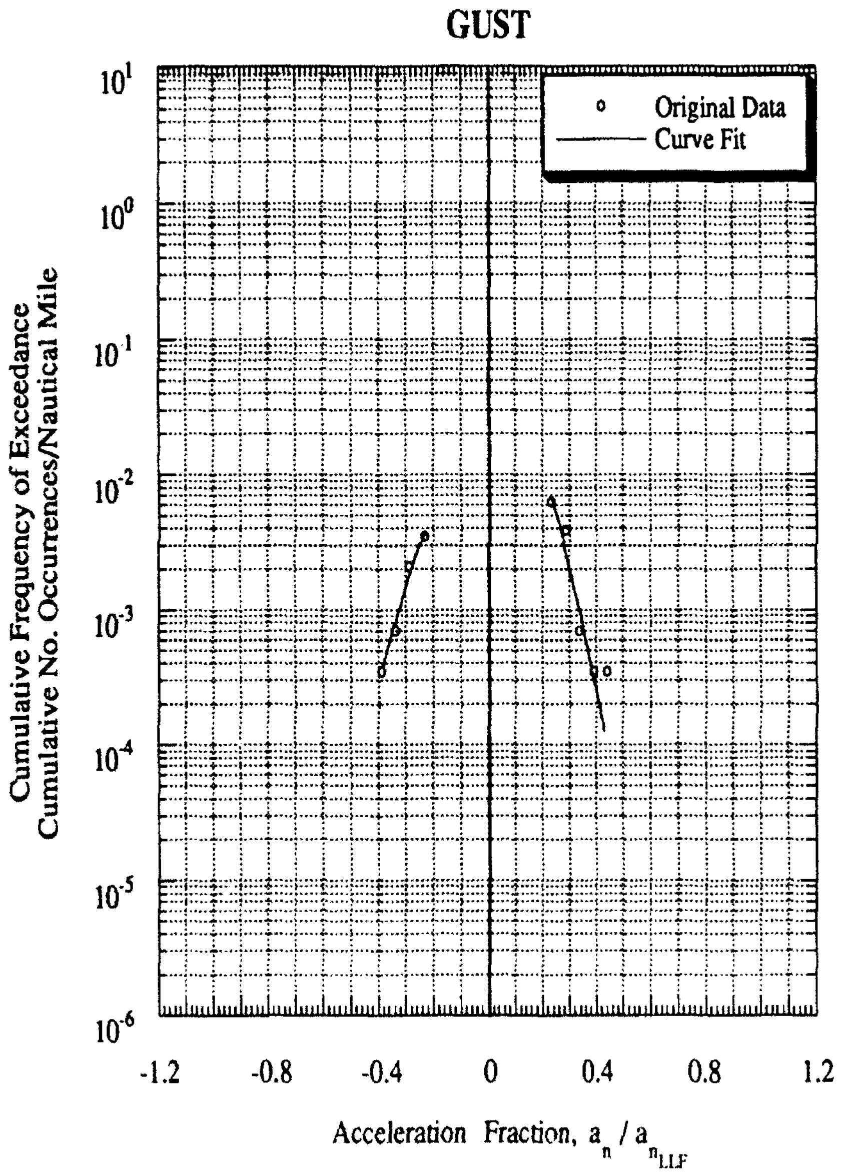
Gust negative:
Curve fit original data ($-0.350 < x < -0.233$)
$\log(y) = -2.308 - 9.383x^2 - 0.596\log(x)$
Curve fit for extrapolation ($-1.200 < x < -0.350$)
$\log(y) = -0.629 - 7.307x$

Gust positive:
Curve fit original data ($0.233 < x < 0.350$)
$\log(y) = -2.118 - 11.766x^2 - 0.942\log(x)$
Curve fit for extrapolation ($0.350 < x < 1.400$)
$\log(y) = 0.161 - 9.405x$

Maneuver negative:
Curve fit original data ($-0.400 < x < -0.192$)
$\log(y) = -0.754 - 15.589x^2 - 0.892\log(x)$
Curve fit for extrapolation ($-0.900 < x < -0.400$)
$\log(y) = 2.482 - 13.440x$

Maneuver positive:
Curve fit original data ($0.192 < x < 0.850$)
$\log(y) = 0.272 - 4.257x^2 + 0.366\log(x)$
Curve fit for extrapolation ($0.850 < x < 1.600$)
$\log(y) = 3.163 - 7.050x$

Figure C-54 Load Spectra for Airplane 34, Aerial Application



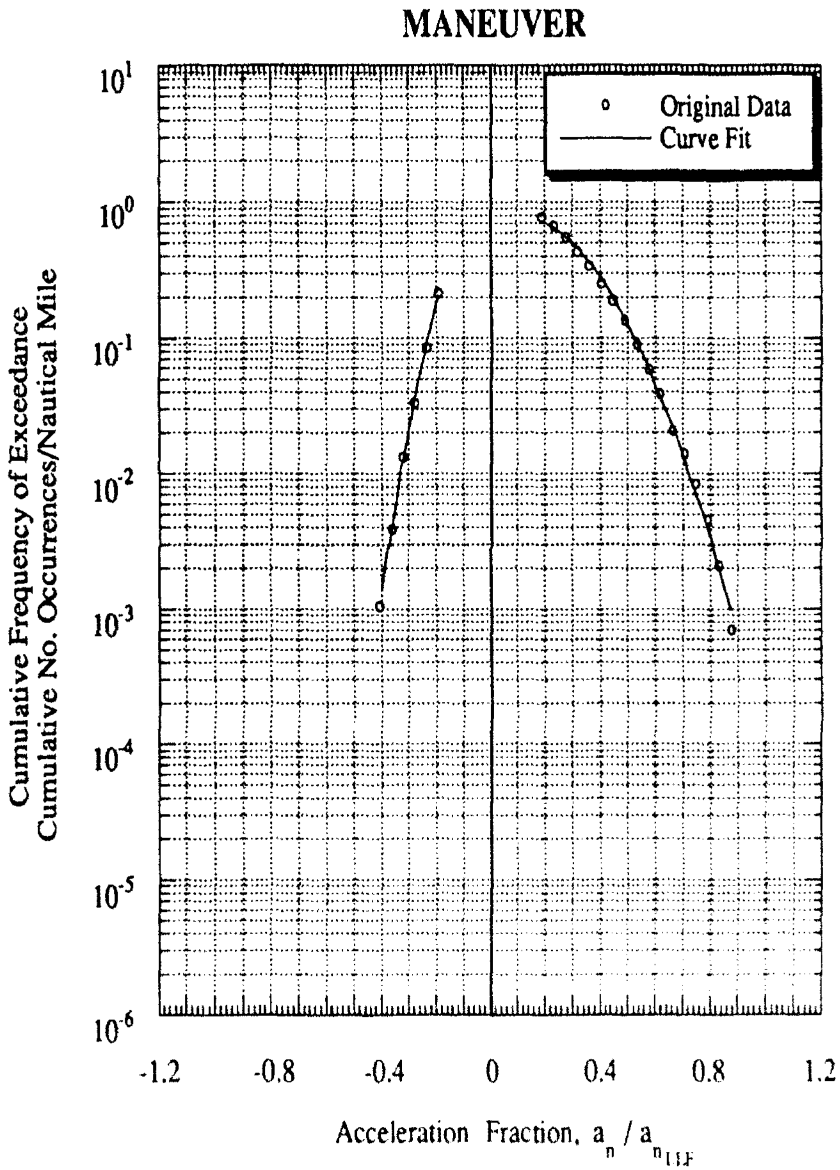


Table C-55 Tabulated Data for Airplane 34[1]

Total Nautical Miles = 42184 Total Hours = 477

GUST				MANEUVER			
negative		positive		negative		positive	
Acceleration Fraction	Cumulative Frequency of Exceedance	Acceleration Fraction	Cumulative Frequency of Exceedance	Acceleration Fraction	Cumulative Frequency of Exceedance	Acceleration Fraction	Cumulative Frequency of Exceedance
-0.250	0.012[illegible]070	0.250	0.0095572	-0.200	0.3628680	0.200	1.4988641
-0.300	0.0036547	0.300	0.0029179	-0.250	0.2117706	0.250	1.0167410
-0.350	0.0012551	0.350	0.0010008	-0.300	0.1043204	0.300	0.6762516
-0.400	0.0004798	0.400	0.0003701	-0.350	0.0436805	0.350	0.4421897
-0.450	0.0001981	0.450	0.0001438	-0.400	0.0156109	0.400	0.2847078
-0.500	0.8663E-04	0.500	0.5762E-04	-0.450	0.0047748	0.450	0.1806857
-0.550	0.3876E-04	0.550	0.2334E-04	-0.500	0.0012522	0.500	0.1131059
-0.600	0.1735E-04	0.600	0.9456E-05	-0.550	0.0002819	0.550	0.0698714
-0.650	0.7762E-05	0.650	0.3831E-05	-0.600	0.5455E-04	0.600	0.0426115
-0.700	0.3474E-05	0.700	0.1552E-05			0.650	0.0256618
-0.750	0.1554E-05					0.700	0.0152642
						0.750	0.0089695
						0.800	0.0052074
						0.850	0.0029873
						0.900	0.0016936
						0.950	0.0009489
						1.000	0.0005254
						1.050	0.0002876
						1.100	0.0001556
						1.150	0.8322E-04
						1.200	0.4400E-04
						1.250	0.2313E-04

NOTE: for curve fits $x = |x|$

Curve fit original data ($-0.500 < x < -0.233$)
$\log(y) = -5.491 - 1.663x^2 - 6.126\log(x)$
Curve fit for extrapolation ($-1.200 < x < -0.500$)
$\log(y) = -0.570 - 6.984x$

Curve fit original data ($0.233 < x < 0.500$)
$\log(y) = -5.083 - 3.145x^2 - 5.415\log(x)$
Curve fit for extrapolation ($0.500 < x < 1.400$)
$\log(y) = -0.315 - 7.848x$

Curve fit original data ($-0.600 < x < -0.192$)
$\log(y) = 0.456 - 12.769x^2 + 0.551\log(x)$
Curve fit for extrapolation ($-0.900 < x < -0.600$)
$\log(y) = 4.691 - 14.923x$

Curve fit original data ($0.192 \le x < 1.200$)
$\log(y) = 1.030 - 3.343x - 0.966x^2 + 0.210\log(x)$
Curve fit for extrapolation ($1.200 < x < 1.600$)
$\log(y) = 2.347 - 5.586x$

Figure C-55 Load Spectra for Airplane 34[1], Aerial Application

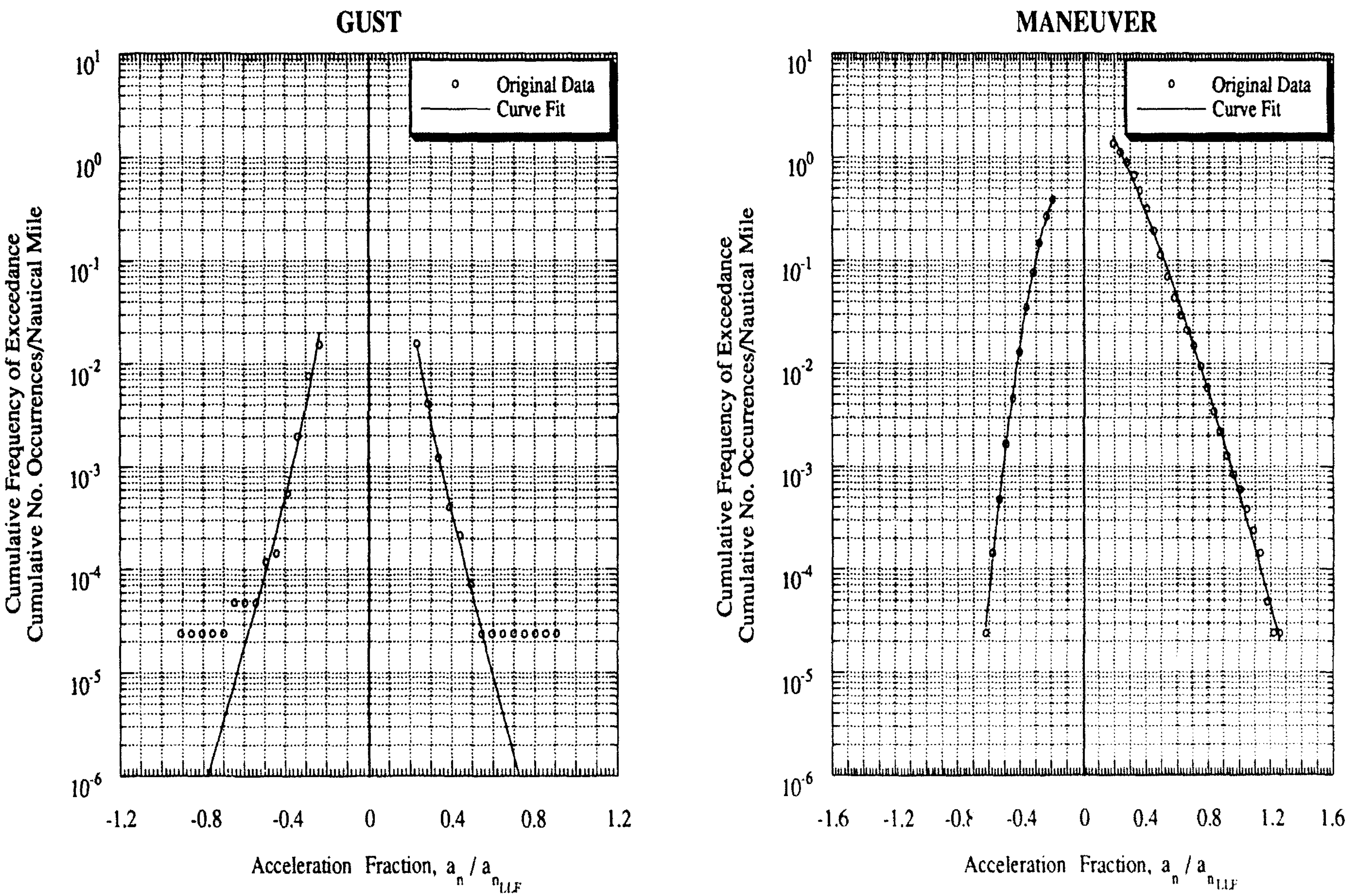


Table C-56 Tabulated Data for Airplane 34^2

Total Nautical Miles = 15642 Total Hours = 187

GUST				MANEUVER			
negative		positive		negative		positive	
Acceleration Fraction	Cumulative Frequency of Exceedance	Acceleration Fraction	Cumulative Frequency of Exceedance	Acceleration Fraction	Cumulative Frequency of Exceedance	Acceleration Fraction	Cumulative Frequency of Exceedance
-0.250	0.0135911	0.250	0.0226083	-0.200	0.0413136	0.200	0.3991491
-0.300	0.0030618	0.300	0.0054406	-0.250	0.0128752	0.250	0.2058648
-0.350	0.0008759	0.350	0.0014945	-0.300	0.0046009	0.300	0.1053235
-0.400	0.0002989	0.400	0.0004466	-0.350	0.0017836	0.350	0.0524219
-0.450	0.0001168	0.450	0.0001407	-0.400	0.0007257	0.400	0.0250900
-0.500	0.4835E-04			-0.450	0.0003034	0.450	0.0114613
						0.500	0.0049716
						0.550	0.0020403
						0.600	0.0007901
						0.650	0.0002881
						0.700	0.0001019
						0.750	0.3602E-04
						0.800	0.1274E-04

NOTE: for curve fits $x = |x|$

Curve fit original data $(-0.450 < x < -0.233)$
$\log(y) = -6.899 + 0.406x^2 - 8.316\log(x)$
Curve fit for extrapolation $(-1.200 < x < -0.450)$
$\log(y) = -0.486 - 7.660x$

Curve fit original data $(0.233 < x < 0.450)$
$\log(y) = -5.230 - 4.121x^2 - 6.381\log(x)$
Curve fit for extrapolation $(0.450 < x < 1.400)$
$\log(y) = 0.589 - 9.868x$

Curve fit original data $(-0.450 < x < -0.192)$
$\log(y) = -4.299 - 3.642x^2 - 4.379\log(x)$
Curve fit for extrapolation $(-0.900 < x < -0.450)$
$\log(y) = -0.141 - 7.504x$

Curve fit original data $(0.192 < x < 0.650)$
$\log(y) = -1.228 - 6.155x^2 - 1.538\log(x)$
Curve fit for extrapolation $(0.650 < x < 1.600)$
$\log(y) = 2.328 - 9.029x$

Figure C-56 Load Spectra for Airplane 34[2], Aerial Application

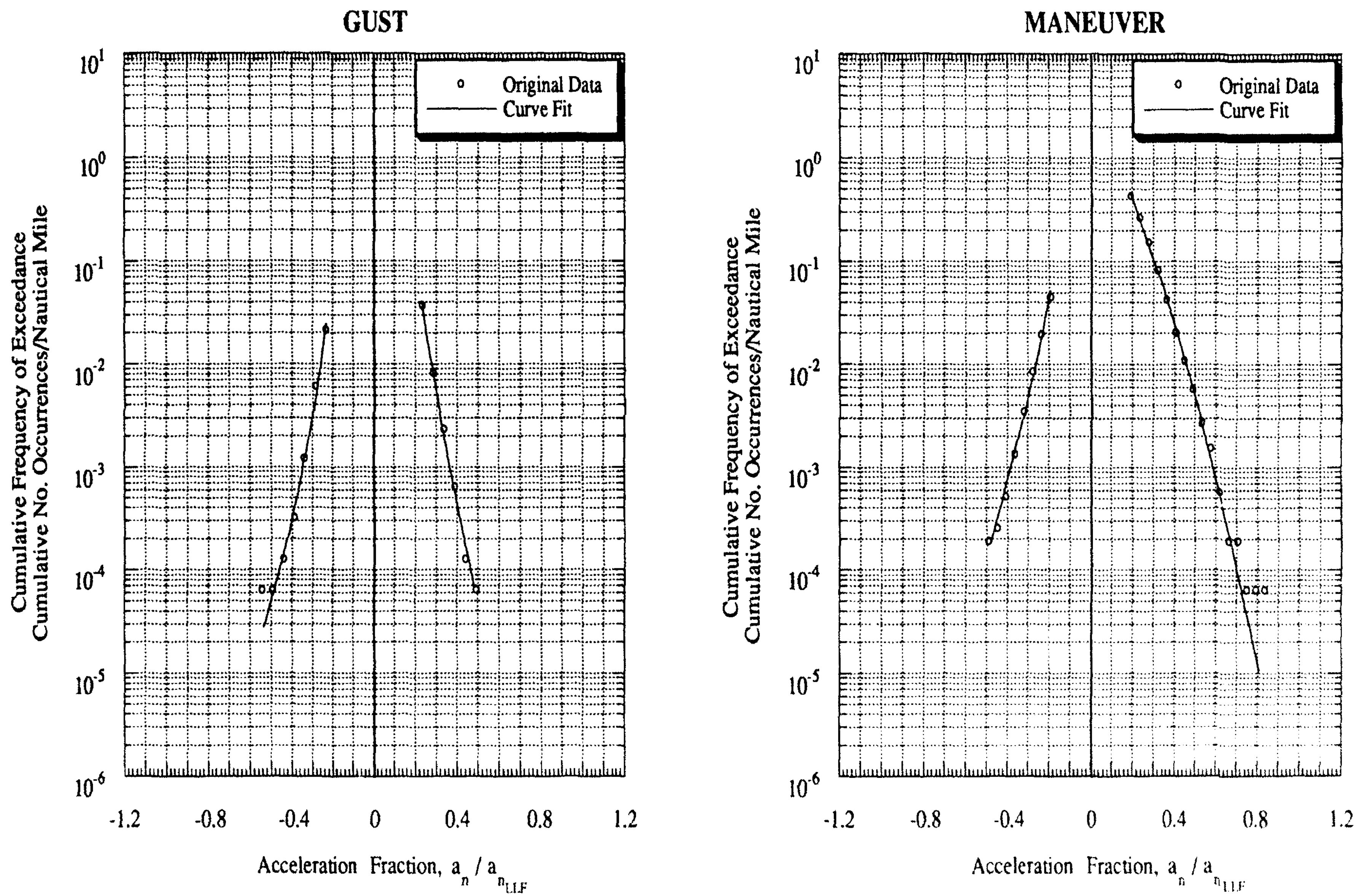


Table C-57 Tabulated Data for Airplane 34[3]

Total Nautical Miles = 57709 Total Hours = 661

GUST				MANEUVER			
negative		positive		negative		positive	
Acceleration Fraction	Cumulative Frequency of Exceedance	Acceleration Fraction	Cumulative Frequency of Exceedance	Acceleration Fraction	Cumulative Frequency of Exceedance	Acceleration Fraction	Cumulative Frequency of Exceedance
-0.250	0.0170951	0.250	0.0669792	-0.200	0.0508049	0.200	0.6546080
-0.300	0.0051493	0.300	0.0269963	-0.250	0.0182151	0.250	0.3030485
-0.350	0.0017526	0.350	0.0107115	-0.300	0.0064038	0.300	0.1468053
-0.400	0.0006464	0.400	0.0041075	-0.350	0.0021442	0.350	0.0721959
-0.450	0.0002514	0.450	0.0015043	-0.400	0.0006720	0.400	0.0353974
-0.500	0.0001013	0.500	0.0005219	-0.450	0.0001949	0.450	0.0171022
		0.550	0.0001706	-0.500	0.5192E-04	0.500	0.0080779
		0.600	0.5227E-04			0.550	0.0037089
						0.600	0.0016484
						0.650	0.0007069
						0.700	0.0002918
						0.750	0.0001157
						0.800	0.4401E-04

NOTE: for curve fits $x = |x|$

Curve fit original data ($-0.500 < x < -0.233$)
$\log(y) = -4.923 - 2.968x^2 - 5.550\log(x)$
Curve fit for extrapolation ($-1.200 < x < -0.500$)
$\log(y) = -0.100 - 7.789x$

Curve fit original data ($0.233 < x < 0.600$)
$\log(y) = -2.184 - 7.330x^2 - 2.438\log(x)$
Curve fit for extrapolation ($0.600 < x < 1.400$)
$\log(y) = 2.055 - 10.561x$

Curve fit original data ($-0.500 < x < -0.192$)
$\log(y) = -2.510 - 9.874x^2 - 2.304\log(x)$
Curve fit for extrapolation ($-0.900 < x < -0.500$)
$\log(y) = 1.653 - 11.876x$

Curve fit original data ($0.192 < x < 0.800$)
$\log(y) = -1.676 - 4.551x^2 - 2.395\log(x)$
Curve fit for extrapolation ($0.800 < x < 1.600$)
$\log(y) = 2.509 - 8.582x$

Figure C-57 Load Spectra for Airplane 3.1[3], Aerial Application

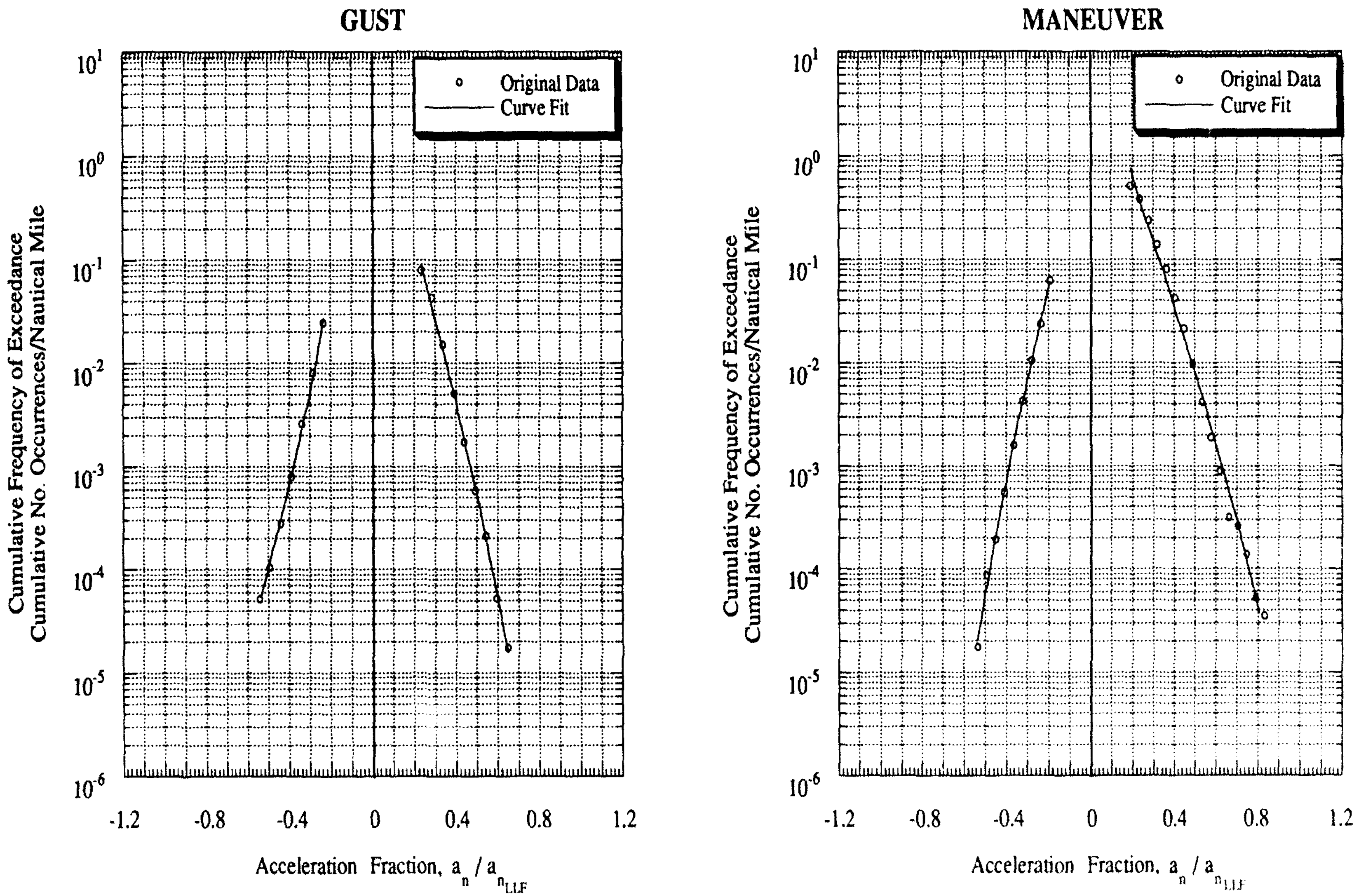


Table C-58 Tabulated Data for Airplane 35

Total Nautical Miles = 33858   Total Hours = 360

GUST				MANEUVER			
negative		positive		negative		positive	
Acceleration Fraction	Cumulative Frequency of Exceedance	Acceleration Fraction	Cumulative Frequency of Exceedance	Acceleration Fraction	Cumulative Frequency of Exceedance	Acceleration Fraction	Cumulative Frequency of Exceedance
-0.200	0.0078987	0.200	0.0060569	-0.200	0.0948252	0.150	1.1757: 0
-0.250	0.0025188	0.250	0.0014034	-0.250	0.0533860	0.200	0.8175621
-0.300	0.0008362	0.300	0.0003424	-0.300	0.0243974	0.250	0.4923529
-0.350	0.0002773	0.350	0.8345E-04	-0.350	0.0091536	0.300	0.2732732
-0.400	0.8967E-04	0.400	0.2009E-04	-0.400	0.0028386	0.350	0.1445087
-0.450	0.2782E-04	0.450	0.4838E-05	-0.450	0.0007308	0.400	0.0742622
		0.500	0.1165E-05	-0.500	0.0001566	0.450	0.0375637
						0.500	0.0188661
						0.550	0.0094670
						0.600	0.0047682
						0.650	0.0024189
						0.700	0.0012394
						0.750	0.0006427
						0.800	0.0003379
						0.850	0.0001804
						0.900	0.9789E-04

NOTE: for curve fits $x = |x|$

Curve fit original data ($-0.450 < x < -0.195$)
$\log(y) = -4.055 - 8.044x^2 - 3.254\log(x)$
Curve fit for extrapolation ($-1.200 < x < -0.450$)
$\log(y) = 0.115 - 10.380x$

Curve fit original data ($0.195 < x < 0.350$)
$\log(y) = -4.718 - 10.284x^2 - 4.166\log(x)$
Curve fit for extrapolation ($0.350 < x < 1.400$)
$\log(y) = 0.250 - 12.368x$

Curve fit original data ($-0.500 < x < -0.179$)
$\log(y) = 0.200 - 14.944x^2 + 0.895\log(x)$
Curve fit for extrapolation ($-0.900 < x < -0.500$)
$\log(y) = 3.278 - 14.166x$

Curve fit original data ($0.161 < x < 0.900$)
$\log(y) = 3.754 - 10.48x + 2.213x^2 + 2.623\log(x)$
Curve fit for extrapolation ($0.900 < x < 1.600$)
$\log(y) = 0.703 - 5.235x$

Figure C-58 Load Spectra for Airplane 35, Aerial Application

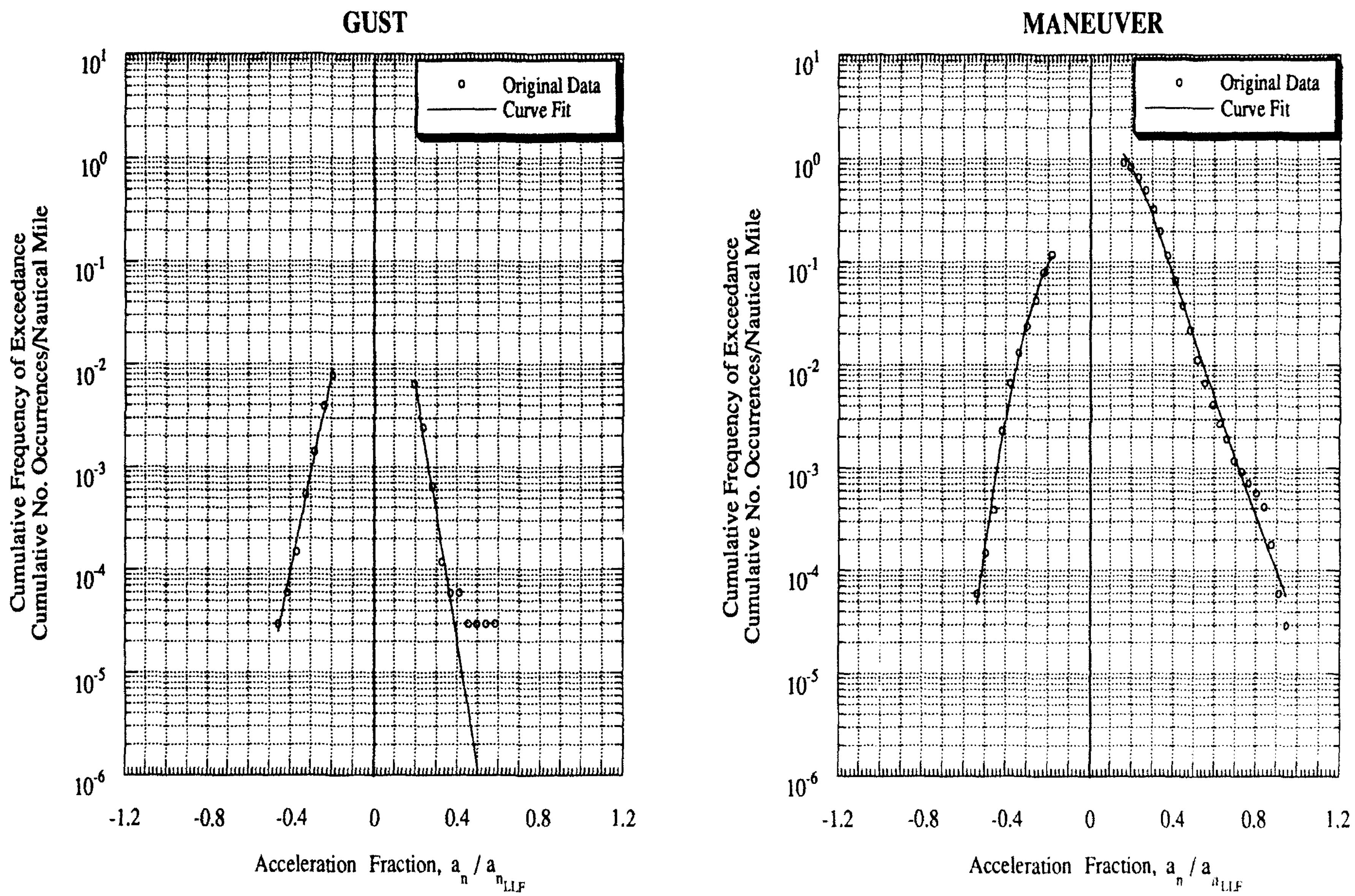


Table C-59 Tabulated Data for Airplane 35[1]

Total Nautical Miles = 62879 Total Hours = 623

GUST negative Acceleration Fraction	GUST negative Cumulative Frequency of Exceedance	GUST positive Acceleration Fraction	GUST positive Cumulative Frequency of Exceedance	MANEUVER negative Acceleration Fraction	MANEUVER negative Cumulative Frequency of Exceedance	MANEUVER positive Acceleration Fraction	MANEUVER positive Cumulative Frequency of Exceedance
-0.200	0.0526482	0.200	0.0474794	-0.200	0.2496670	0.150	1.6096860
-0.250	0.0141934	0.250	0.0186933	-0.250	0.1483958	0.200	1.4349951
-0.300	0.0044998	0.300	0.0058867	-0.300	0.0657307	0.250	1.1643250
-0.350	0.0015746	0.350	0.0014861	-0.350	0.0222457	0.300	0.8683925
-0.400	0.0005855	0.400	0.0003012	-0.400	0.0058389	0.350	0.5985118
-0.450	0.0002258	0.450	0.4903E-04	-0.450	0.0012000	0.400	0.3823971
-0.500	0.8881E-04	0.500	0.7157E-05	-0.500	0.0001944	0.450	0.2269477
		0.550	0.1045E-05			0.500	0.1252881
						0.550	0.0644017
						0.600	0.0308465
						0.650	0.0137746
						0.700	0.0057372
						0.750	0.0022296
						0.800	0.0008087
						0.850	0.0002738
						0.900	0.8655E-04
						0.950	0.2555E-04
						1.000	0.7289E-05
						1.050	0.2079E-05

NOTE: for curve fits x = |x|

Gust negative
Curve fit original data ($-0.500 < x < -0.195$)
$\log(y) = -4.636 - 3.701x^2 - 5.015\log(x)$
Curve fit for extrapolation ($-1.200 < x < -0.500$)
$\log(y) = -0.023 - 8.057x$

Gust positive
Curve fit original data ($0.195 < x < 0.450$)
$\log(y) = -0.448 - 18.764x^2 + 0.179\log(x)$
Curve fit for extrapolation ($0.450 < x < 1.400$)
$\log(y) = 3.212 - 16.715x$

Maneuver negative
Curve fit original data ($-0.500 < x < -0.179$)
$\log(y) = 1.519 - 18.544x^2 + 1.974\log(x)$
Curve fit for extrapolation ($-0.900 < x < -0.500$)
$\log(y) = 4.703 - 16.829x$

Maneuver positive
Curve fit original data ($0.161 < x < 0.950$)
$\log(y) = 0.682 - 5.834x^2 + 0.418\log(x)$
Curve fit for extrapolation ($0.950 < x < 1.600$)
$\log(y) = 5.757 - 10.894x$

Figure C-59 Load Spectra for Airplane 35[1], Aerial Application

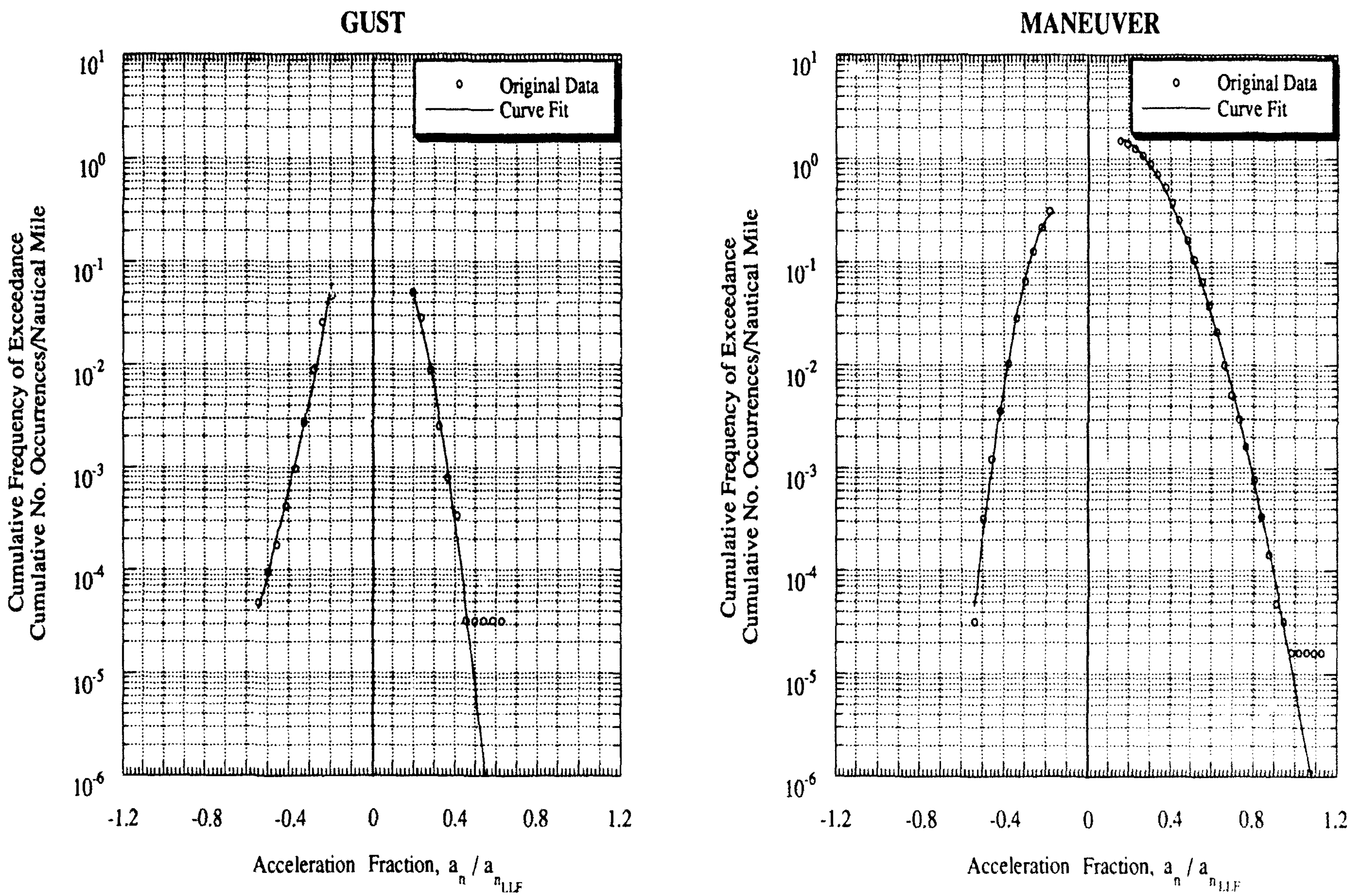


Table C-60 Tabulated Data for Airplane 35[2]

Total Nautical Miles = 44895   Total Hours = 445

GUST				MANEUVER			
negative		positive		negative		positive	
Acceleration Fraction	Cumulative Frequency of Exceedance	Acceleration Fraction	Cumulative Frequency of Exceedance	Acceleration Fraction	Cumulative Frequency of Exceedance	Acceleration Fraction	Cumulative Frequency of Exceedance
-0.200	0.0168402	0.200	0.0307744	-0.200	0.1309917	0.150	1.8041270
-0.250	0.0050197	0.250	0.0099505	-0.250	0.0473736	0.200	1.4750600
-0.300	0.0012945	0.300	0.0039221	-0.300	0.0160348	0.250	1.1385829
-0.350	0.0002838	0.350	0.0017698	-0.350	0.0049672	0.300	0.8297204
		0.400	0.0008806	-0.400	0.0013896	0.350	0.5708356
		0.450	0.0004716	-0.450	0.0003481	0.400	0.3707682
		0.500	0.0002674	-0.500	0.7760E-04	0.450	0.2273559
		0.550	0.0001586			0.500	0.1316200
		0.600	0.9759E-04			0.550	0.0719366
						0.600	0.0371185
						0.650	0.0180818
						0.700	0.0083159
						0.750	0.0036106
						0.800	0.0014800
						0.850	0.0005728
						0.900	0.0002093
						0.950	0.7218E-04

NOTE: for curve fits $x = |x|$

Curve fit original data ($-0.350 < x < -0.195$)
$\log(y) = -2.035 - 17.451x^2 - 1.373\log(x)$
Curve fit for extrapolation ($-1.200 < x < -0.350$)
$\log(y) = 1.325 - 13.919x$

Curve fit original data ($0.195 < x < 0.600$)
$\log(y) = -4.967 - 0.405x^2 - 4.966\log(x)$
Curve fit for extrapolation ($0.600 < x < 1.400$)
$\log(y) = -1.563 - 4.080x$

Curve fit original data ($-0.500 < x < -0.179$)
$\log(y) = -1.637 - 12.020x^2 - 1.767\log(x)$
Curve fit for extrapolation ($-0.900 < x < -0.500$)
$\log(y) = 2.667 - 13.555x$

Curve fit original data ($0.161 < x < 0.950$)
$\log(y) = 0.369 - 4.998x^2$
Curve fit for extrapolation ($0.950 < x < 1.600$)
$\log(y) = 0.369 - 4.998x^2$

Figure C-60 Load Spectra for Airplane 35², Aerial Application

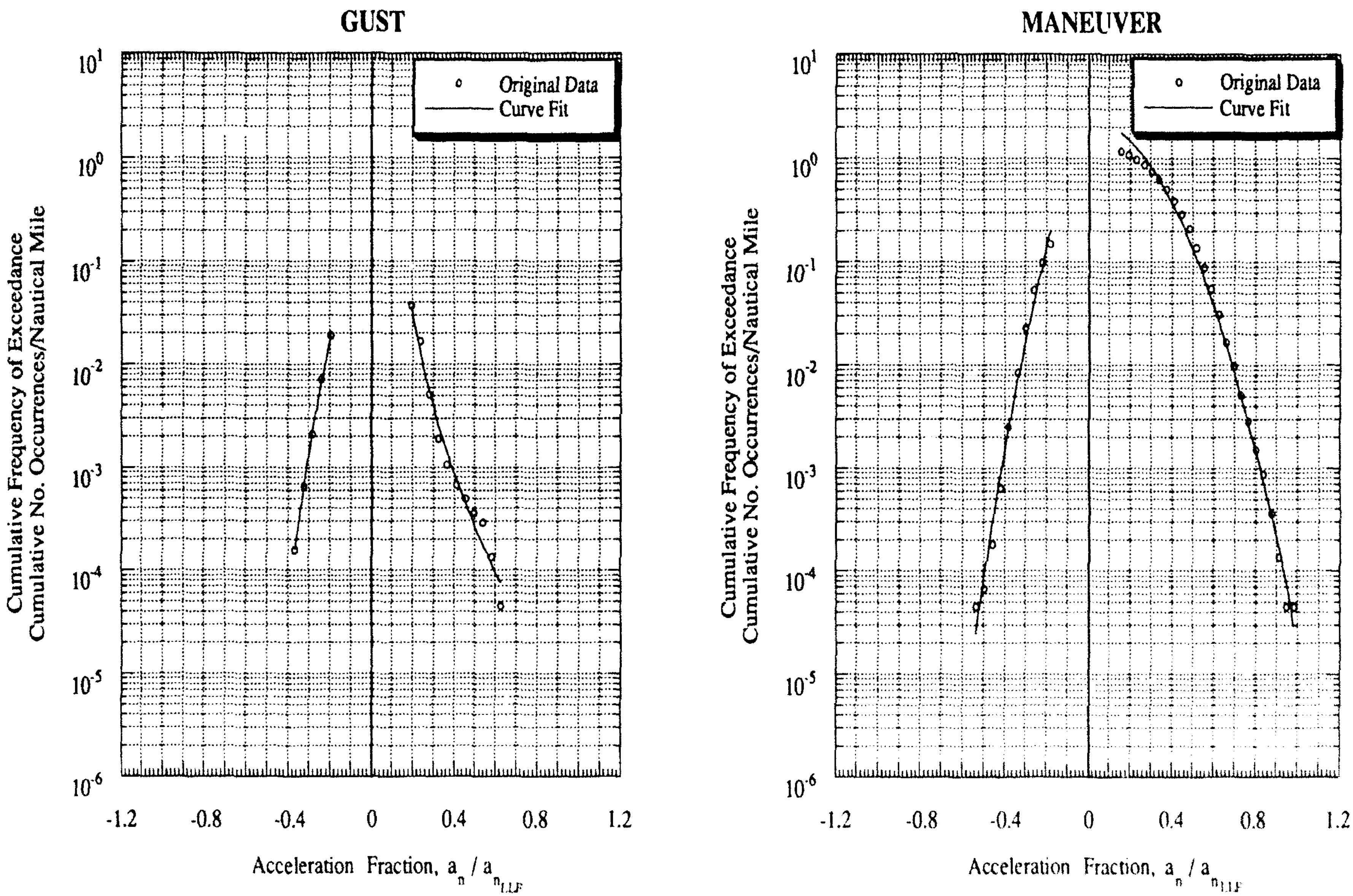


Table C-61 Tabulated Data for Airplane 36

Total Nautical Miles = 18838 Total Hours = 208

GUST				MANEUVER			
negative		positive		negative		positive	
Acceleration Fraction	Cumulative Frequency of Exceedance	Acceleration Fraction	Cumulative Frequency of Exceedance	Acceleration Fraction	Cumulative Frequency of Exceedance	Acceleration Fraction	Cumulative Frequency of Exceedance
-0.200	0.0865083	0.200	0.0906058	-0.200	0.0763287	0.150	1.3629780
-0.250	0.0274962	0.250	0.0300294	-0.250	0.0485367	0.200	0.7370383
-0.300	0.0090155	0.300	0.0087516	-0.300	0.0239397	0.250	0.4134452
-0.350	0.0029298	0.350	0.0022064	-0.350	0.0093574	0.300	0.2324708
-0.400	0.0009214	0.400	0.0004765	-0.400	0.0029360	0.350	0.1286444
-0.450	0.0002761	0.450	0.8761E-04	-0.450	0.0007456	0.400	0.0693010
						0.450	0.0360873
						0.500	0.0180777
						0.550	0.0086820
						0.600	0.0039873
						0.650	0.0017478
						0.700	0.0007301
						0.750	0.0002903
						0.800	0.0001098

NOTE: for curve fits $x = |x|$

Curve fit original data ($-0.450 < x < -0.195$)
$\log(y) = -2.932 - 8.508x^2 - 3.161\log(x)$
Curve fit for extrapolation ($-1.200 < x < -0.450$)
$\log(y) = 1.260 - 10.708x$

Curve fit original data ($0.195 < x < 0.450$)
$\log(y) = -1.316 - 15.751x^2 - 1.292\log(x)$
Curve fit for extrapolation ($0.450 < x < 1.400$)
$\log(y) = 2.883 - 15.423x$

Curve fit original data ($-0.450 < x < -0.179$)
$\log(y) = 0.711 - 16.049x^2 + 1.697\log(x)$
Curve fit for extrapolation ($-0.900 < x < -0.450$)
$\log(y) = 2.635 - 12.806x$

Curve fit original data ($0.161 < x < 0.800$)
$\log(y) = -0.947 - 4.926x^2 - 1.447\log(x)$
Curve fit for extrapolation ($0.800 < x < 1.600$)
$\log(y) = 2.975 - 8.668x$

Figure C-61 Load Spectra for Airplane 36, Aerial Application

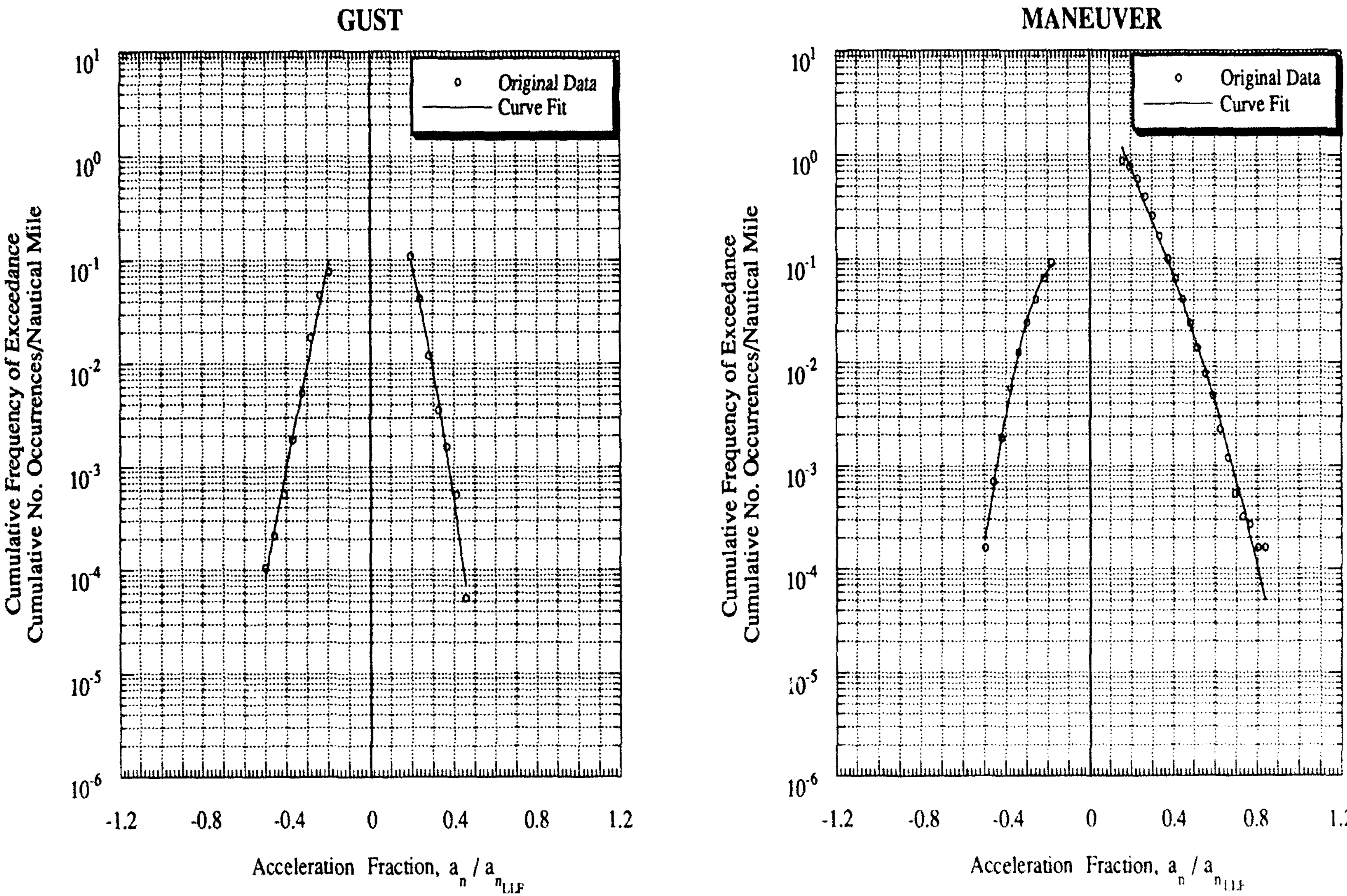


Table C-62 Tabulated Data for Airplane 36A

Total Nautical Miles = 6071 Total Hours = 72

GUST				MANEUVER			
negative		positive		negative		positive	
Acceleration Fraction	Cumulative Frequency of Exceedance	Acceleration Fraction	Cumulative Frequency of Exceedance	Acceleration Fraction	Cumulative Frequency of Exceedance	Acceleration Fraction	Cumulative Frequency of Exceedance
-0.200	0.0011482	0.200	0.0047085	-0.200	0.3492737	0.150	1.5856330
		0.250	0.0008916	-0.250	0.1203025	0.200	0.8950107
				-0.300	0.0326978	0.250	0.5024049
				-0.350	0.0070129	0.300	0.2733993
				-0.400	0.0011869	0.350	0.1422812
						0.400	0.0702385
						0.450	0.0327194
						0.500	0.0143312
						0.550	0.0058871
						0.600	0.0022638
						0.650	0.0008137

NOTE: for curve fits x = |x|

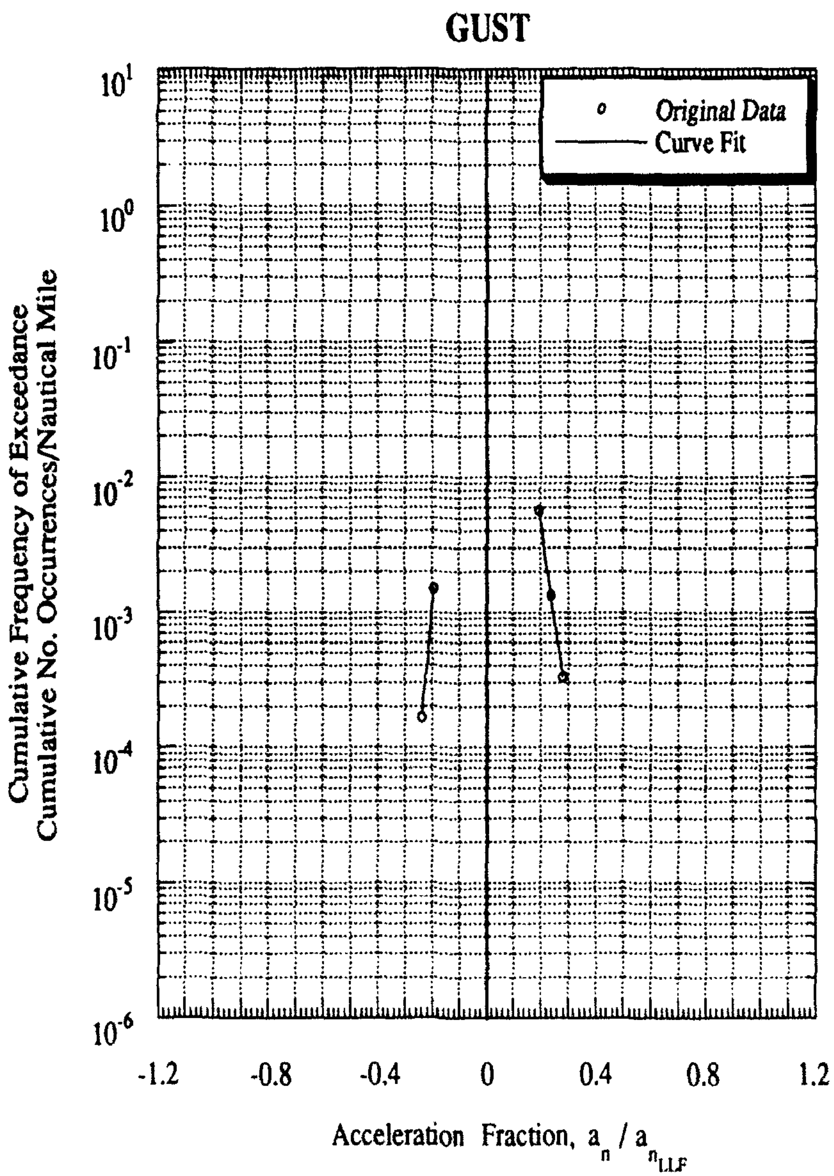
Curve fit original data (-0.200 < x < -0.195)
$\log(y) = 1.499 - 22.193x$
Curve fit for extrapolation (-1.200 < x < -0.200)
$\log(y) = 1.499 - 22.193x$

Curve fit original data (0.195 < x < 0.250)
$\log(y) = -5.209 - 11.524x^2 - 4.782\log(x)$
Curve fit for extrapolation (0.250 < x < 1.400)
$\log(y) = 0.467 - 14.069x$

Curve fit original data (-0.400 < x < -0.179)
$\log(y) = 0.366 - 20.573x^2$
Curve fit for extrapolation (-0.900 < x < -0.400)
$\log(y) = 0.366 - 20.573x^2$

Curve fit original data (0.161 < x < 0.650)
$\log(y) = -0.540 - 6.511x^2 - 1.076\log(x)$
Curve fit for extrapolation (0.650 < x < 1.600)
$\log(y) = 2.880 - 9.184x$

Figure C-62 Load Spectra for Airplane 36A, Aerial Application



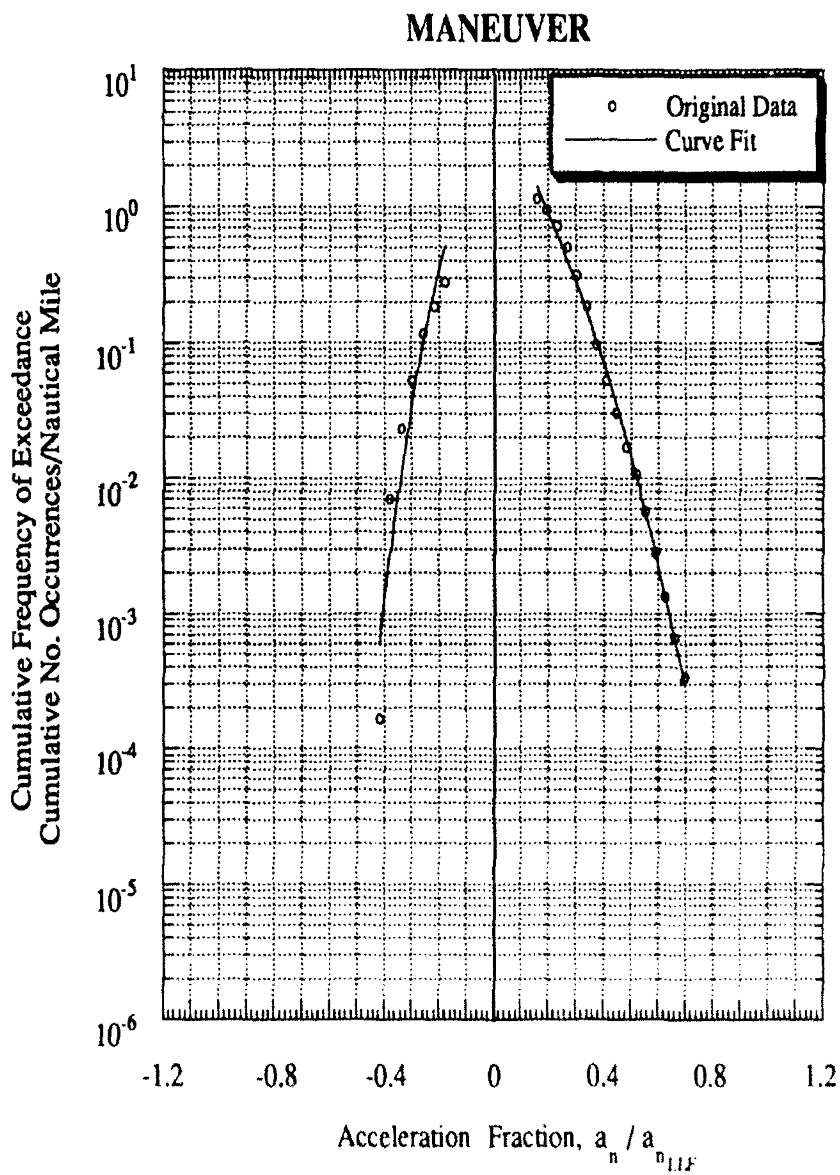


Table C-63 Tabulated Data for Airplane 37

Total Nautical Miles = 14032   Total Hours = 175

GUST negative: Acceleration Fraction	GUST negative: Cumulative Frequency of Exceedance	GUST positive: Acceleration Fraction	GUST positive: Cumulative Frequency of Exceedance	MANEUVER negative: Acceleration Fraction	MANEUVER negative: Cumulative Frequency of Exceedance	MANEUVER positive: Acceleration Fraction	MANEUVER positive: Cumulative Frequency of Exceedance
-0.250	0.0095625	0.250	0.0119019	-0.200	0.0437780	0.150	0.6872298
-0.300	0.0018211	0.300	0.0022772	-0.250	0.0100931	0.200	0.4067096
-0.350	0.0003991	0.350	0.0004612	-0.300	0.0018209	0.250	0.1820371
-0.400	0.9532E-04	0.400	0.9464E-04			0.300	0.0720160
						0.350	0.0273656
						0.400	0.0104965
						0.450	0.0041962
						0.500	0.0017870
						0.550	0.0008234
						0.600	0.0004153

NOTE: for curve fits x = |x|

Gust negative

Curve fit original data ($-0.400 < x < -0.246$)
$\log(y) = -6.019 - 5.437x^2 - 7.208\log(x)$
Curve fit for extrapolation ($-1.200 < x < -0.400$)
$\log(y) = 0.849 - 12.176x$

Gust positive

Curve fit original data ($0.246 < x < 0.400$)
$\log(y) = -4.853 - 9.325x^2 - 5.832\log(x)$
Curve fit for extrapolation ($0.400 < x < 1.400$)
$\log(y) = 1.493 - 13.792x$

Maneuver negative

Curve fit original data ($-0.300 < x < -0.179$)
$\log(y) = -1.005 - 24.472x^2 - 0.894\log(x)$
Curve fit for extrapolation ($-0.900 < x < -0.300$)
$\log(y) = 2.053 - 15.977x$

Maneuver positive

Curve fit original data ($0.161 < x < 0.600$)
$\log(y) = 8.777 - 25.39x + 12.58x^2 + 6.573\log(x)$
Curve fit for extrapolation ($0.600 < x < 1.600$)
$\log(y) = -0.066 - 5.526x$

Figure C-63 Load Spectra for Airplane 37, Aerial Application

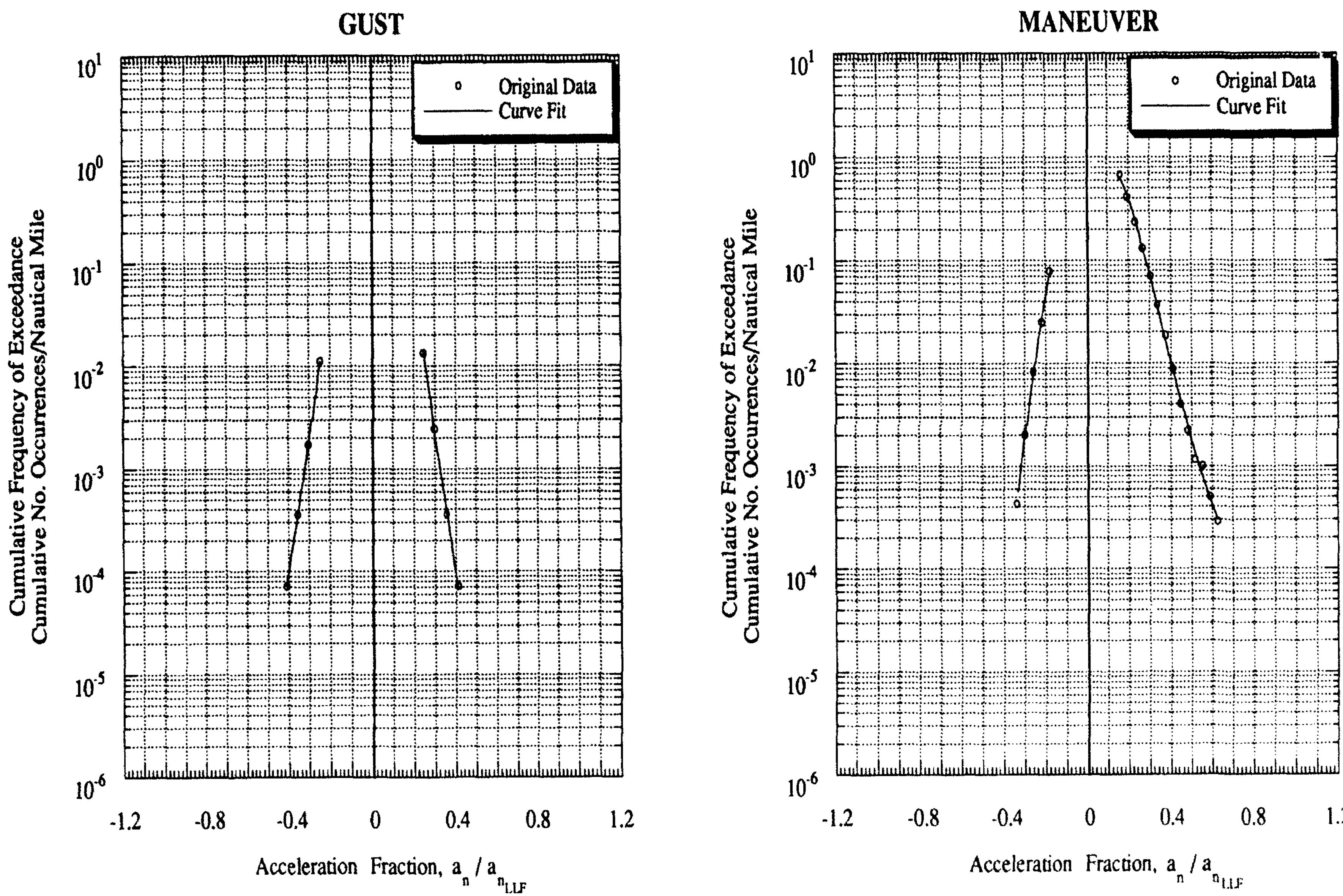


Table C-64 Tabulated Data for Airplane 37[1]

Total Nautical Miles = 24905 Total Hours = 342

GUST				MANEUVER			
negative		positive		negative		positive	
Acceleration Fraction	Cumulative Frequency of Exceedance	Acceleration Fraction	Cumulative Frequency of Exceedance	Acceleration Fraction	Cumulative Frequency of Exceedance	Acceleration Fraction	Cumulative Frequency of Exceedance
-0.250	0.0096155	0.250	0.0126262	-0.200	0.3192527	0.150	3.8290761
-0.300	0.0028831	0.300	0.0043292	-0.250	0.1477520	0.200	2.5837619
-0.350	0.0010426	0.350	0.0014928	-0.300	0.0576204	0.250	1.5581141
-0.400	0.0004325	0.400	0.0005050	-0.350	0.0189349	0.300	0.8397194
-0.450	0.0001993	0.450	0.0001650	-0.400	0.0052432	0.350	0.4044429
-0.500	0.9977E-04			-0.450	0.0012234	0.400	0.1740878
				-0.500	0.0002405	0.450	0.0669680
						0.500	0.0230226
						0.550	0.0070734
						0.600	0.0019422
						0.650	0.0004766

NOTE: for curve fits x = |x|

Curve fit original data ($-0.500 < x < -0.246$)
$\log(y) = -6.010 + 0.058x^2 - 6.627\log(x)$
Curve fit for extrapolation ($-1.200 < x < -0.500$)
$\log(y) = -1.152 - 5.698x$

Curve fit original data ($0.246 < x < 0.450$)
$\log(y) = -3.396 - 7.501x^2 - 3.266\log(x)$
Curve fit for extrapolation ($0.450 < x < 1.400$)
$\log(y) = 0.674 - 9.903x$

Curve fit original data ($-0.500 < x < -0.179$)
$\log(y) = 0.099 - 14.871x^2$
Curve fit for extrapolation ($-0.900 < x < -0.500$)
$\log(y) = 0.099 - 14.871x^2$

Curve fit original data ($0.161 < x < 0.650$)
$\log(y) = 0.803 - 9.762x^2$
Curve fit for extrapolation ($0.650 < x < 1.600$)
$\log(y) = 0.803 - 9.762x^2$

Figure C-64 Load Spectra for Airplane 37[1], Aerial Application

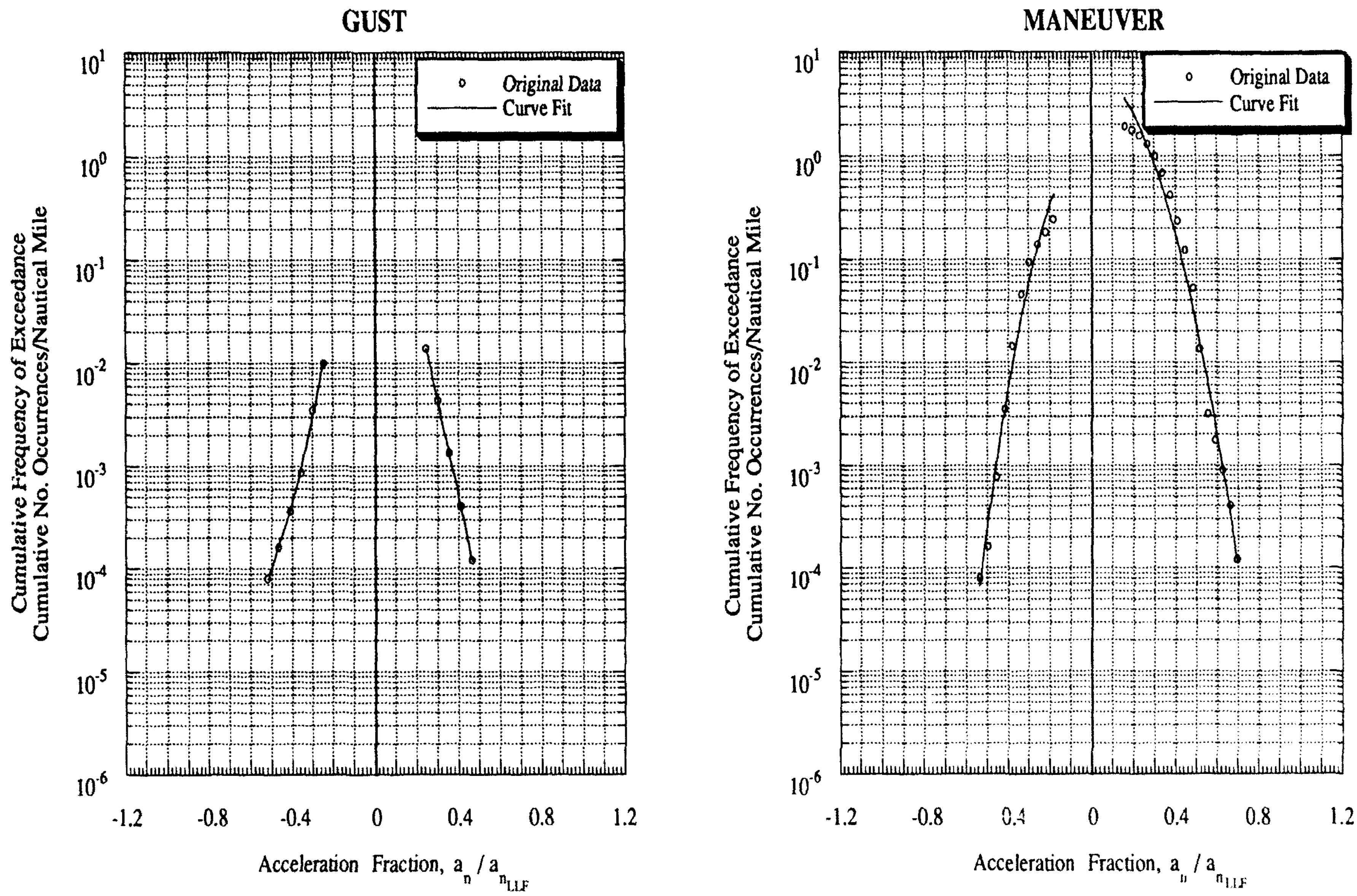


Table C-65 Tabulated Data for Airplane 4

Total Nautical Miles = 206478   Total Hours = 1254

GUST negative		GUST positive		MANEUVER negative		MANEUVER positive	
Acceleration Fraction	Cumulative Frequency of Exceedance	Acceleration Fraction	Cumulative Frequency of Exceedance	Acceleration Fraction	Cumulative Frequency of Exceedance	Acceleration Fraction	Cumulative Frequency of Exceedance
-0.250	0.0116069	0.250	0.0149342	-0.200	0.0004165	0.150	0.0065868
-0.300	0.0036047	0.300	0.0041713	-0.250	0.0001540	0.200	0.0022987
-0.350	0.0012810	0.350	0.0014444	-0.300	0.7705E-04	0.250	0.0009669
-0.400	0.0004990	0.400	0.0005869	-0.350	0.1892E-04	0.300	0.0004530
-0.450	0.0002073	0.450	0.0002700			0.350	0.0002267
-0.500	0.9015E-04	0.500	0.0001373			0.400	0.0001182
-0.550	0.4047E-04	0.550	0.7588E-04			0.450	0.6314E-04
-0.600	0.1858E-04	0.600	0.4497E-04			0.500	0.3419E-04
-0.650	0.8601E-05	0.650	0.2831E-04			0.550	0.1862E-04
-0.700	0.3981E-05	0.700	0.1879E-04				
		0.750	0.1307E-04				
		0.800	0.9485E-05				

NOTE: for curve fits x = |x|

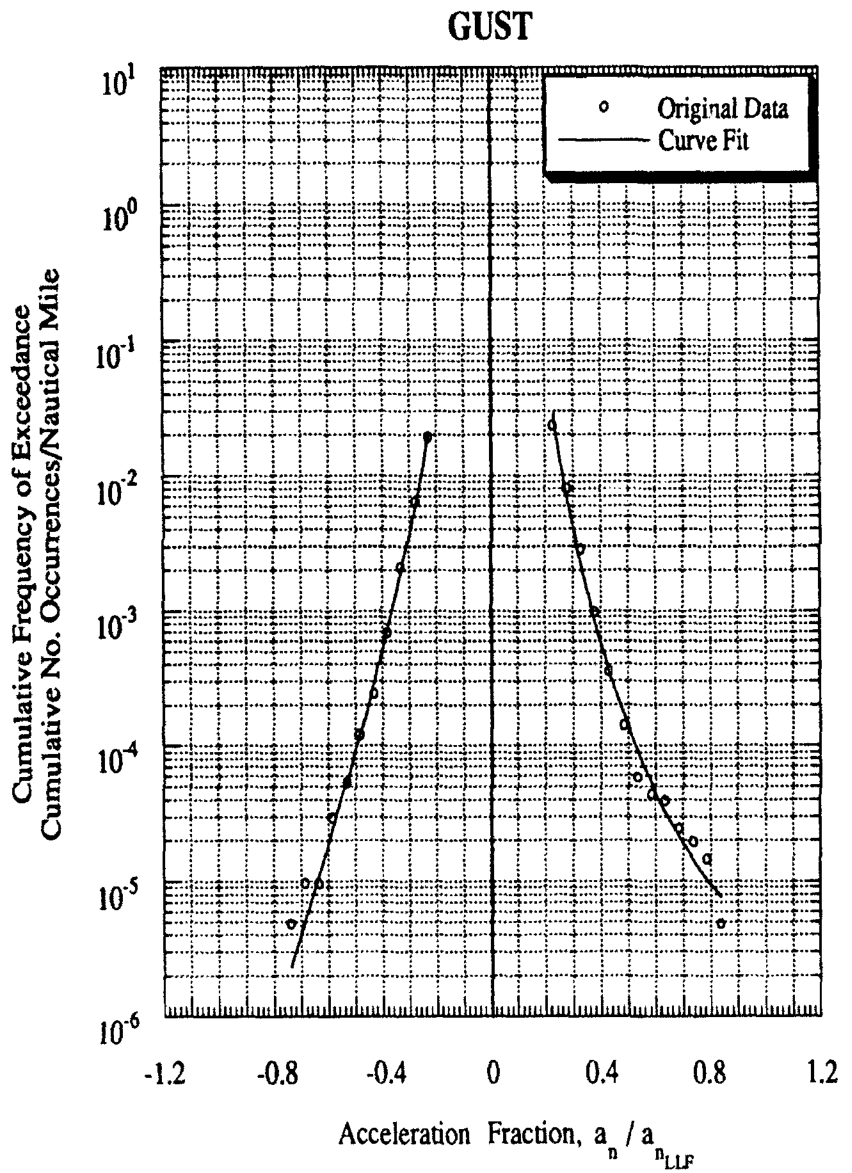
Curve fit original data ($-0.600 < x < -0.228$)
$\log(y) = -5.210 - 2.158x^2 - 5.664\log(x)$
Curve fit for extrapolation ($-1.200 < x < -0.600$)
$\log(y) = -0.717 - 6.690x$

Curve fit original data ($0.228 < x < 0.800$)
$\log(y) = -6.265 + 0.837x^2 - 7.286\log(x)$
Curve fit for extrapolation ($0.800 < x < 2.000$)
$\log(y) = -2.930 - 2.616x$

Curve fit original data ($-0.350 < x \leq -0.179$)
$\log(y) = -101.57 + 262.6x - 257.75x^2 - 80.09\log(x)$
Curve fit for extrapolation ($-0.800 < x < -0.350$)
$\log(y) = 1.306 - 17.226x$

Curve fit original data ($0.161 < x < 0.550$)
$\log(y) = -4.864 - 2.407x^2 - 3.322\log(x)$
Curve fit for extrapolation ($0.550 < x < 1.600$)
$\log(y) = -1.831 - 5.271x$

Figure C-65 Load Spectra for Airplane 4, Twin-Engine, General Usage



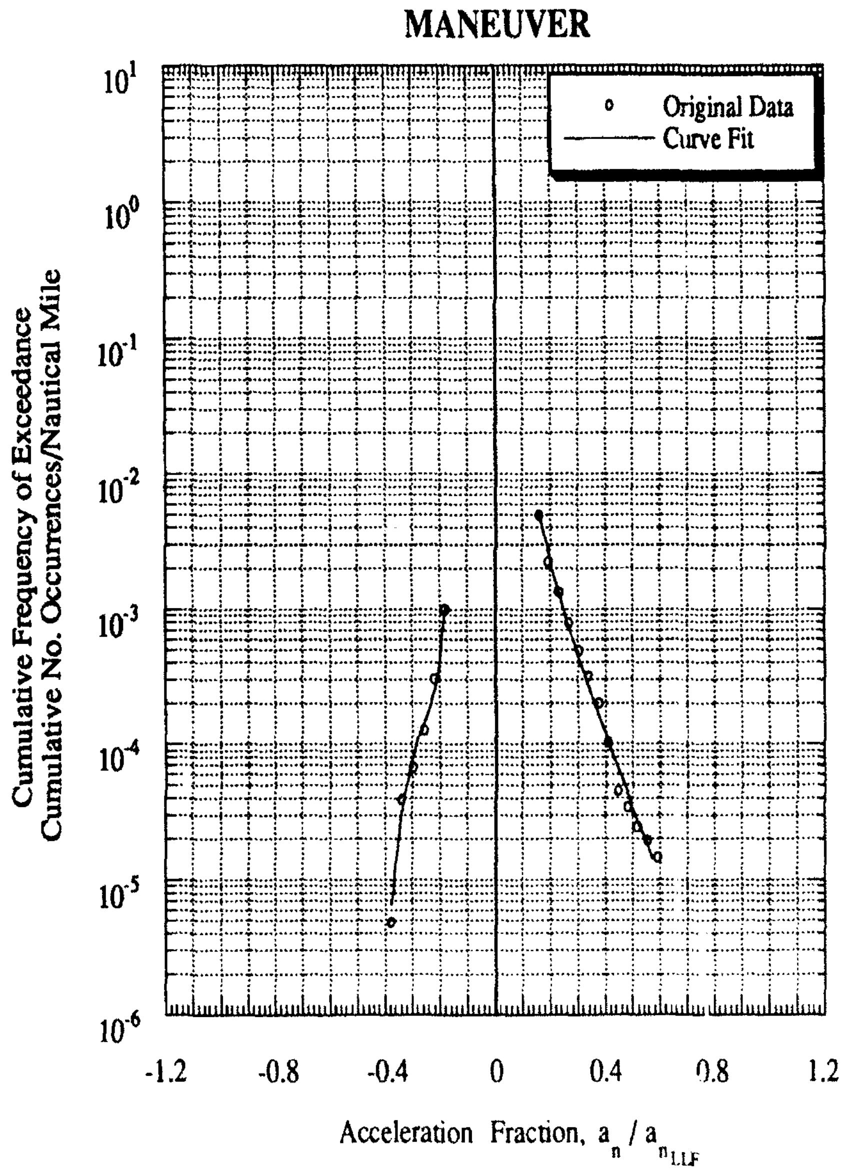


Table C-66 Tabulated Data for Airplane 5

Total Nautical Miles = 86977 Total Hours = 563

GUST				MANEUVER			
negative		positive		negative		positive	
Acceleration Fraction	Cumulative Frequency of Exceedance	Acceleration Fraction	Cumulative Frequency of Exceedance	Acceleration Fraction	Cumulative Frequency of Exceedance	Acceleration Fraction	Cumulative Frequency of Exceedance
-0.200	0.0484977	0.200	0.0565900	-0.200	0.0003514	0.150	0.0042300
-0.250	0.0171612	0.250	0.0185538	-0.250	0.6371E-04	0.200	0.0011507
-0.300	0.0069111	0.300	0.0069742	-0.300	0.1159E-04	0.250	0.0004018
-0.350	0.0030118	0.350	0.0028481			0.300	0.0001629
-0.400	0.0013782	0.400	0.0012237			0.350	0.7262E-04
-0.450	0.0006495	0.450	0.0005418			0.400	0.3451E-04
-0.500	0.0003111	0.500	0.0002437			0.450	0.1680E-04
-0.550	0.0001500	0.550	0.0001103			0.500	0.8181E-05
-0.600	0.7233E-04	0.600	0.4982E-04			0.550	0.3983E-05
-0.650	0.3468E-04	0.650	0.2234E-04				
-0.700	0.1656E-04						
-0.750	0.7905E-05						

NOTE: for curve fits x = |x|

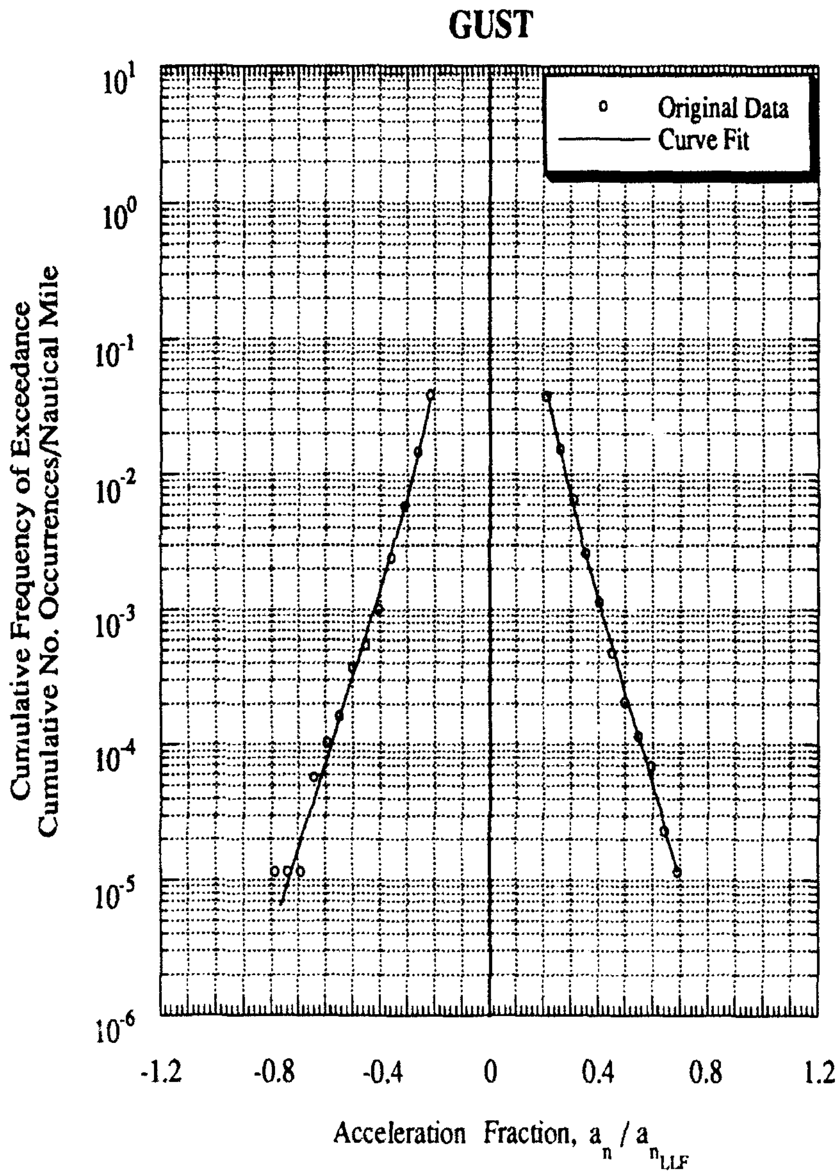
Curve fit original data ($-0.650 < x < -0.214$)
$\log(y) = -3.983 - 2.892x^2 - 3.984\log(x)$
Curve fit for extrapolation ($-1.200 < x < -0.650$)
$\log(y) = -0.286 - 6.422x$

Curve fit original data ($0.214 < x < 0.650$)
$\log(y) = -4.092 - 3.207x^2 - 4.253\log(x)$
Curve fit for extrapolation ($0.650 < x < 2.000$)
$\log(y) = -0.094 - 7.010x$

Curve fit original data ($-0.250 < x < -0.179$)
$\log(y) = -5.648 - 15.601x^2 - 4.031\log(x)$
Curve fit for extrapolation ($-0.800 < x < -0.250$)
$\log(y) = -0.495 - 14.802x$

Curve fit original data ($0.161 < x < 0.400$)
$\log(y) = -5.817 - 2.066x^2 - 4.236\log(x)$
Curve fit for extrapolation ($0.400 < x < 1.600$)
$\log(y) = -1.961 - 6.252x$

Figure C-66 Load Spectra for Airplane 5, Twin-Engine, General Usage



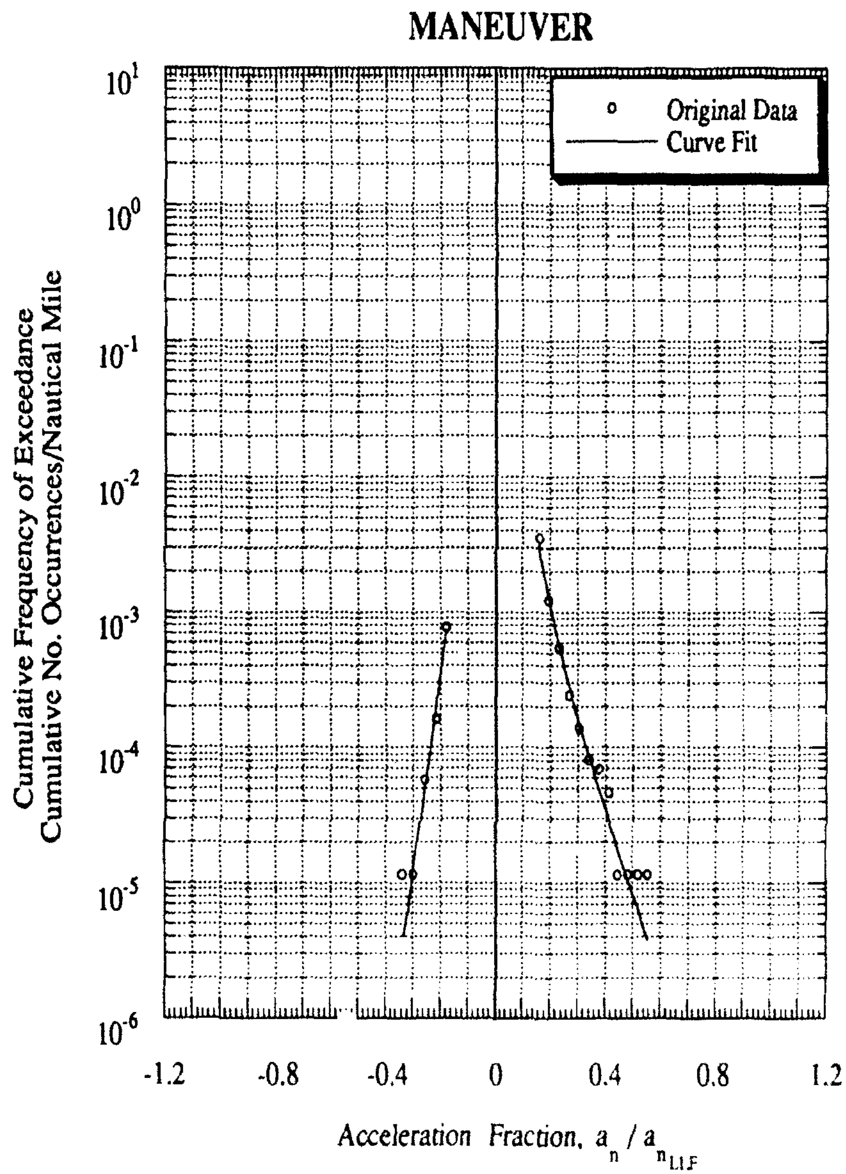


Table C-67 Tabulated Data for Airplane 5[1]

Total Nautical Miles = 41586 **Total Hours = 263**

GUST negative Acceleration Fraction	GUST negative Cumulative Frequency of Exceedance	GUST positive Acceleration Fraction	GUST positive Cumulative Frequency of Exceedance	MANEUVER negative Acceleration Fraction	MANEUVER negative Cumulative Frequency of Exceedance	MANEUVER positive Acceleration Fraction	MANEUVER positive Cumulative Frequency of Exceedance
-0.200	0.0550154	0.200	0.0624145	-0.200	0.0038834	0.150	0.0092687
-0.250	0.0162143	0.250	0.0191551	-0.250	0.0019665	0.200	0.0044103
-0.300	0.0056964	0.300	0.0067098	-0.300	0.0010109	0.250	0.0022664
-0.350	0.0022408	0.350	0.0025385	-0.350	0.0005153	0.300	0.0012004
-0.400	C.0009508	0.400	0.0010036	-0.400	0.0002569	0.350	0.0006391
-0.450	0.0004249	0.450	0.0004059	-0.450	0.0001242	0.400	0.0003370
-0.500	0.0001966	0.500	0.0001655	-0.500	0.5782E-04	0.450	0.0001743
-0.550	0.9317E-04	0.550	0.6736E-04			0.500	0.8790E-04
-0.600	0.4480E-04	0.600	0.2731E-04				
-0.650	0.2165E-04	0.650	0.1107E-04				
		0.700	0.4487E-05				
		0.750	0.1819E-05				

NOTE: for curve fits x = |x|

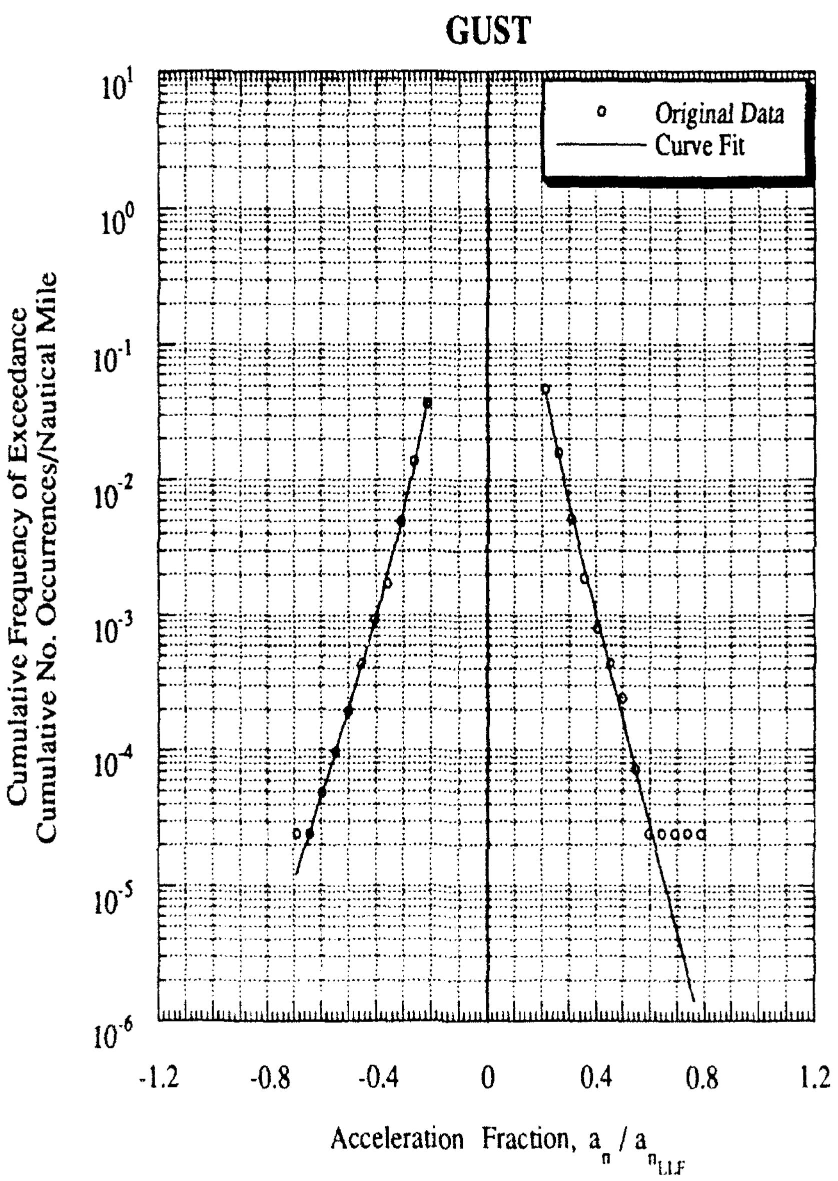
Curve fit for original data (-0.600<x<-0.214)
$\log(y) = -4.625 - 2.280x^2 - 4.946\log(x)$
Curve fit for extrapolation (-1.200<x<-0.600)
$\log(y) = -0.560 - 6.315x$

Curve fit for original data (0.214<x<0.550)
$\log(y) = -4.097 - 3.996x^2 - 4.366\log(x)$
Curve fit for extrapolation (0.550<x<2.000)
$\log(y) = 0.142 - 7.842x$

Curve fit for original data (-0.500<x<-0.179)
$\log(y) = -3.487 - 5.218x^2 - 1.838\log(x)$
Curve fit for extrapolation (-0.800<x<-0.500)
$\log(y) = -0.831 - 6.814x$

Curve fit for original data (0.161<x<0.500)
$\log(y) = -3.558 - 4.364x^2 - 1.970\log(x)$
Curve fit for extrapolation (0.500<x<1.600)
$\log(y) = -1.018 - 6.075x$

Figure C-67 Load Spectra for Airplane 5[1], Twin-Engine, General Usage



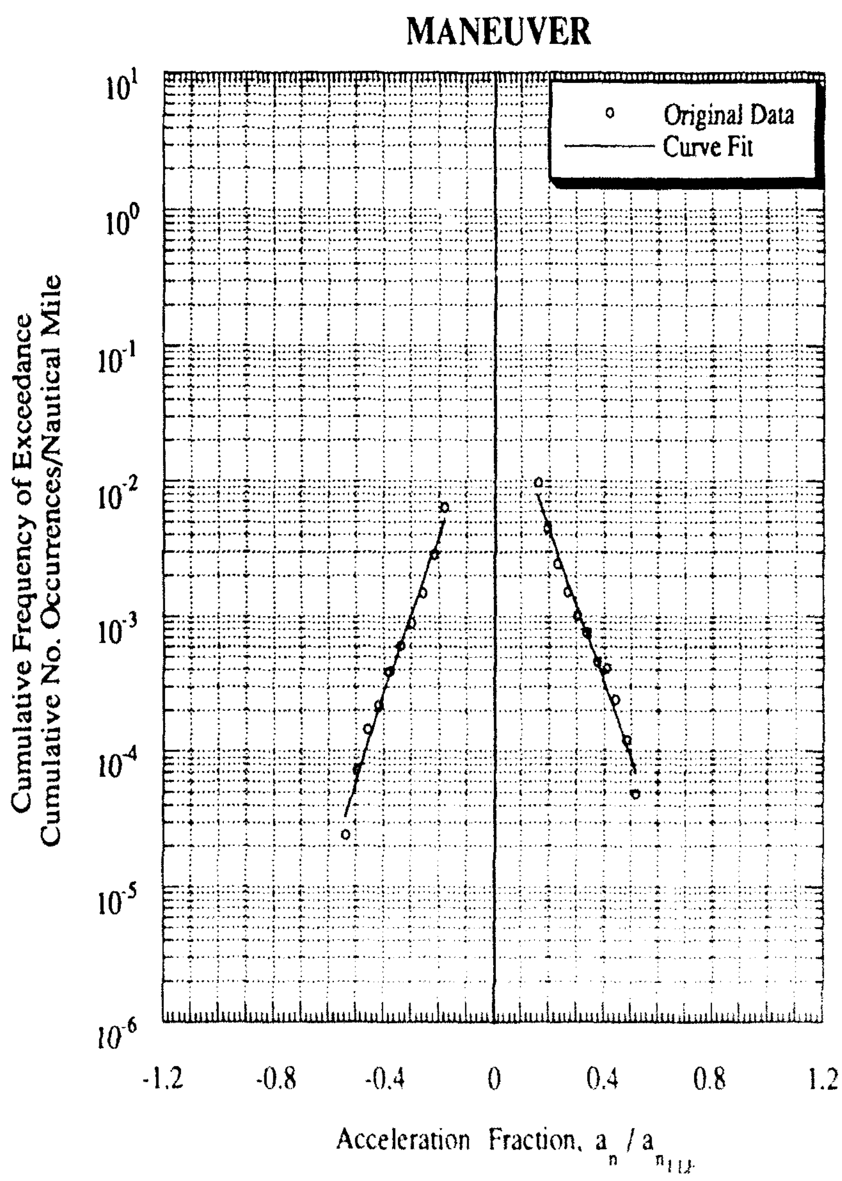


Table C-68 Tabulated Data for Airplane 4A

Total Nautical Miles = 46214 Total Hours = 342

GUST				MANEUVER			
negative		positive		negative		positive	
Acceleration Fraction	Cumulative Frequency of Exceedance	Acceleration Fraction	Cumulative Frequency of Exceedance	Acceleration Fraction	Cumulative Frequency of Exceedance	Acceleration Fraction	Cumulative Frequency of Exceedance
-0.250	0.0142161	0.250	0.0166440	-0.200	0.0167079	0.150	0.0688580
-0.300	0.0055784	0.300	0.0062916	-0.250	0.0061997	0.200	0.0262826
-0.350	0.0021857	0.350	0.0024260	-0.300	0.0018456	0.250	0.0116720
-0.400	0.0008375	0.400	0.0009314	-0.350	0.0004408	0.300	0.0056291
-0.450	0.0003097	0.450	0.0003505	-0.400	0.8446E-04	0.350	0.0028417
-0.500	0.0001095	0.500	0.0001279			0.400	0.0014690
-0.550	0.3677E-04	0.550	0.4493E-04			0.450	0.0007667
-0.600	0.1201E-04					0.500	0.0004001
						0.550	0.0002073
						0.600	0.0001062
						0.650	0.5349E-04
						0.700	0.2671E-04

NOTE: for curve fits $x = |x|$

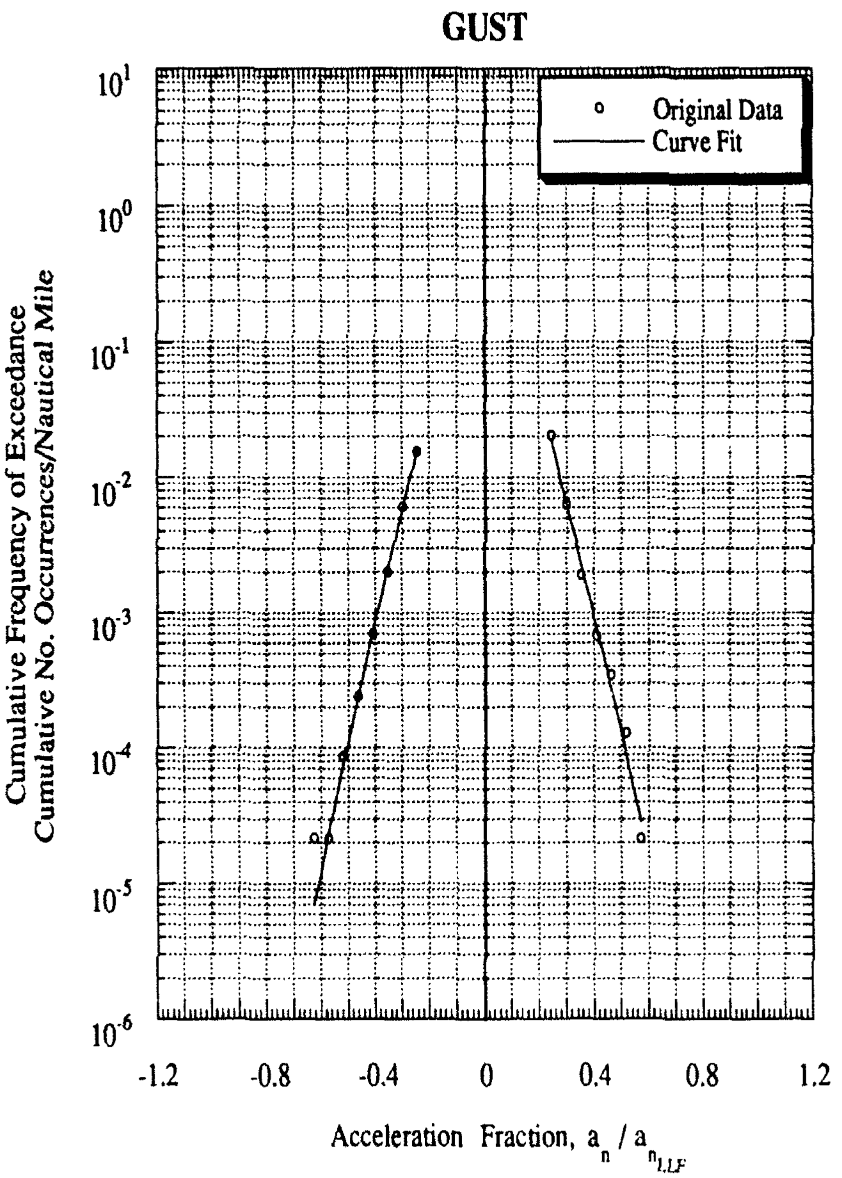
Curve fit for original data ($-0.550 < x < -0.245$)
$\log(y) = -3.073 - 6.859x^2 - 2.749\log(x)$
Curve fit for extrapolation ($-1.200 < x < -0.550$)
$\log(y) = 0.909 - 9.715x$

Curve fit for original data ($0.245 < x < 0.550$)
$\log(y) = -3.328 - 6.126x^2 - 3.208\log(x)$
Curve fit for extrapolation ($0.550 < x < 2.000$)
$\log(y) = 0.752 - 9.272x$

Curve fit for original data ($-0.400 < x < -0.179$)
$\log(y) = -1.012 - 19.135x^2$
Curve fit for extrapolation ($-0.800 < x < -0.400$)
$\log(y) = -1.012 - 19.135x^2$

Curve fit for original data ($0.161 < x < 0.650$)
$\log(y) = -3.487 - 3.145x^2 - 2.907\log(x)$
Curve fit for extrapolation ($0.650 < x < 1.600$)
$\log(y) = -0.351 - 6.032x$

Figure C-68 Load Spectra for Airplane 4A, Twin-Engine, General Usage



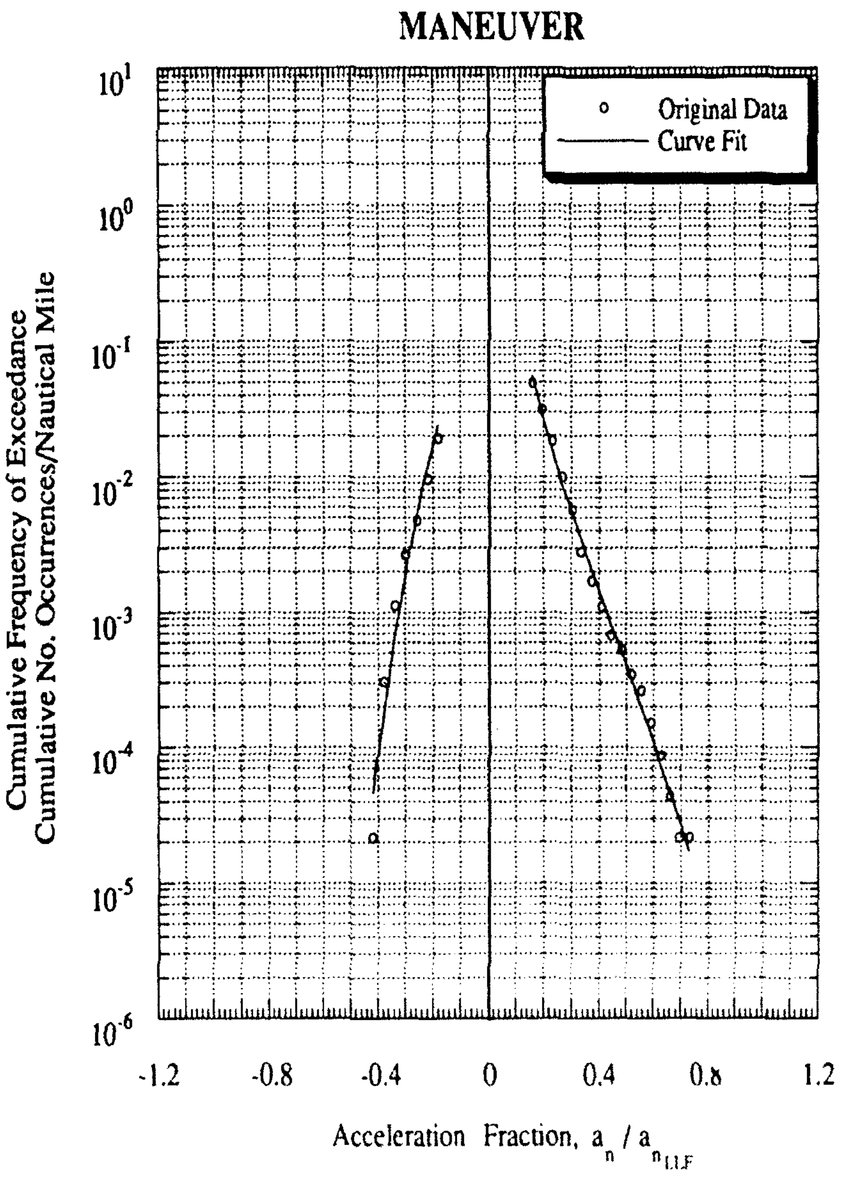


Table C-69 Tabulated Data for Airplane 39

Total Nautical Miles = 274012 Total Hours = 2056

GUST				MANEUVER			
negative		positive		negative		positive	
Acceleration Fraction	Cumulative Frequency of Exceedance	Acceleration Fraction	Cumulative Frequency of Exceedance	Acceleration Fraction	Cumulative Frequency of Exceedance	Acceleration Fraction	Cumulative Frequency of Exceedance
-0.200	0.0132551	0.200	0.0171301	-0.200	0.0006427	0.200	0.0027257
-0.250	0.0035574	0.250	0.0040383	-0.250	0.0001768	0.250	0.0008828
-0.300	0.0011009	0.300	0.0012361	-0.300	0.4505E-04	0.300	0.0003630
-0.350	0.0003697	0.350	0.0004528	-0.350	0.1032E-04	0.350	0.0001770
-0.400	0.0001299	0.400	0.0001891			0.400	0.9827E-04
-0.450	0.4666E-04	0.450	0.8722E-04			0.450	0.6048E-04
-0.500	0.1686E-04	0.500	0.4351E-04			0.500	0.4053E-04
		0.550	0.2312E-04			0.550	0.2919E-04
		0.600	0.1262E-04			0.600	0.2239E-04
		0.650	0.6892E-05			0.650	0.1816E-04
		0.700	0.3764E-05			0.700	0.1548E-04

NOTE: for curve fits x = |x|

Curve fit for original data $(-0.500 < x < -0.191)$
$\log(y) = -5.052 - 4.675x^2 - 4.809\log(x)$
Curve fit for extrapolation $(-1.200 < x < -0.500)$
$\log(y) = -0.347 - 8.852x$

Curve fit for original data $(0.191 < x < 0.550)$
$\log(y) = -6.261 - 0.155x^2 - 6.440\log(x)$
Curve fit for extrapolation $(0.550 < x < 2.000)$
$\log(y) = -1.746 - 5.255x$

Curve fit for original data $(-0.350 < x < -0.180)$
$\log(y) = -4.217 - 14.916x^2 - 2.319\log(x)$
Curve fit for extrapolation $(-0.800 < x < -0.350)$
$\log(y) = -0.325 - 13.319x$

Curve fit for original data $(0.204 < x < 0.700)$
$\log(y) = -6.410 + 1.554x^2 - 5.413\log(x)$
Curve fit for extrapolation $(0.700 < x < 1.600)$
$\log(y) = -3.983 - 1.182x$

Figure C-69 Load Spectra for Airplane 39, Twin-Engine, General Usage

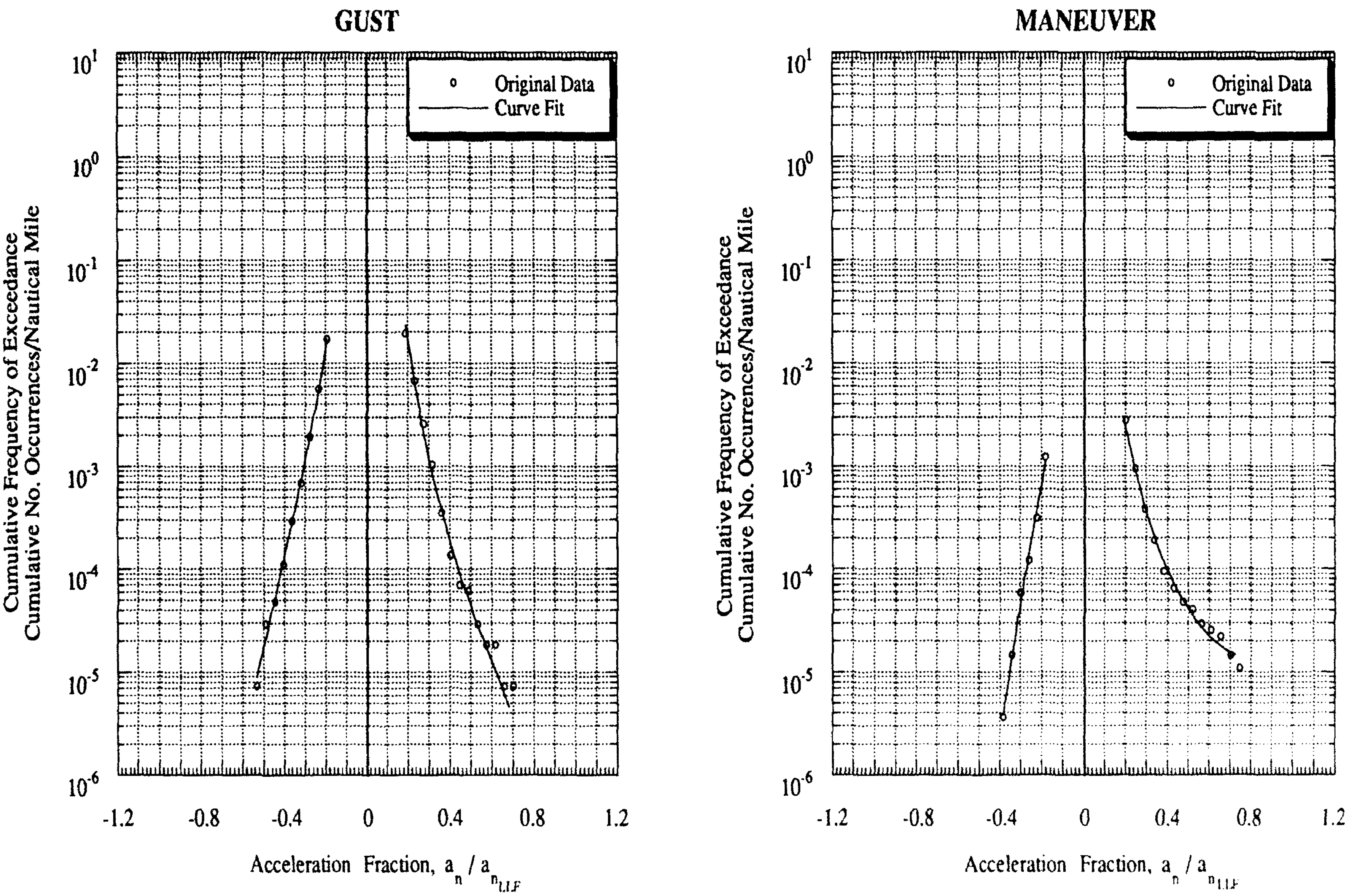


Table C-70 Tabulated Data for Airplane 40

Total Nautical Miles = 508180   Total Hours = 2684

GUST				MANEUVER			
negative		positive		negative		positive	
Acceleration Fraction	Cumulative Frequency of Exceedance	Acceleration Fraction	Cumulative Frequency of Exceedance	Acceleration Fraction	Cumulative Frequency of Exceedance	Acceleration Fraction	Cumulative Frequency of Exceedance
-0.250	0.0210494	0.250	0.0194892	-0.200	0.0006099	0.200	0.0019688
-0.300	0.0070791	0.300	0.0064796	-0.250	0.0001847	0.250	0.0006450
-0.350	0.0027685	0.350	0.0024244	-0.300	0.5101E-04	0.300	0.0002424
-0.400	0.0012060	0.400	0.0009816	-0.350	0.1253E-04	0.350	0.9905E-04
-0.450	0.0005693	0.450	0.0004193	-0.400	0.2702E-05	0.400	0.4260E-04
-0.500	0.0002857	0.500	0.0001858			0.450	0.1889E-04
-0.550	0.0001504	0.550	0.8429E-04			0.500	0.8515E-05
-0.600	0.8218E-04	0.600	0.3883E-04			0.550	0.3856E-05
-0.650	0.4630E-04	0.650	0.1803E-04			0.600	0.1746E-05
-0.700	0.2673E-04	0.700	0.8395E-05				
-0.750	0.1573E-04	0.750	0.3902E-05				
-0.800	0.9341E-05	0.800	0.1811E-05				
-0.850	0.5546E-05						

NOTE: for curve fits x = |x|

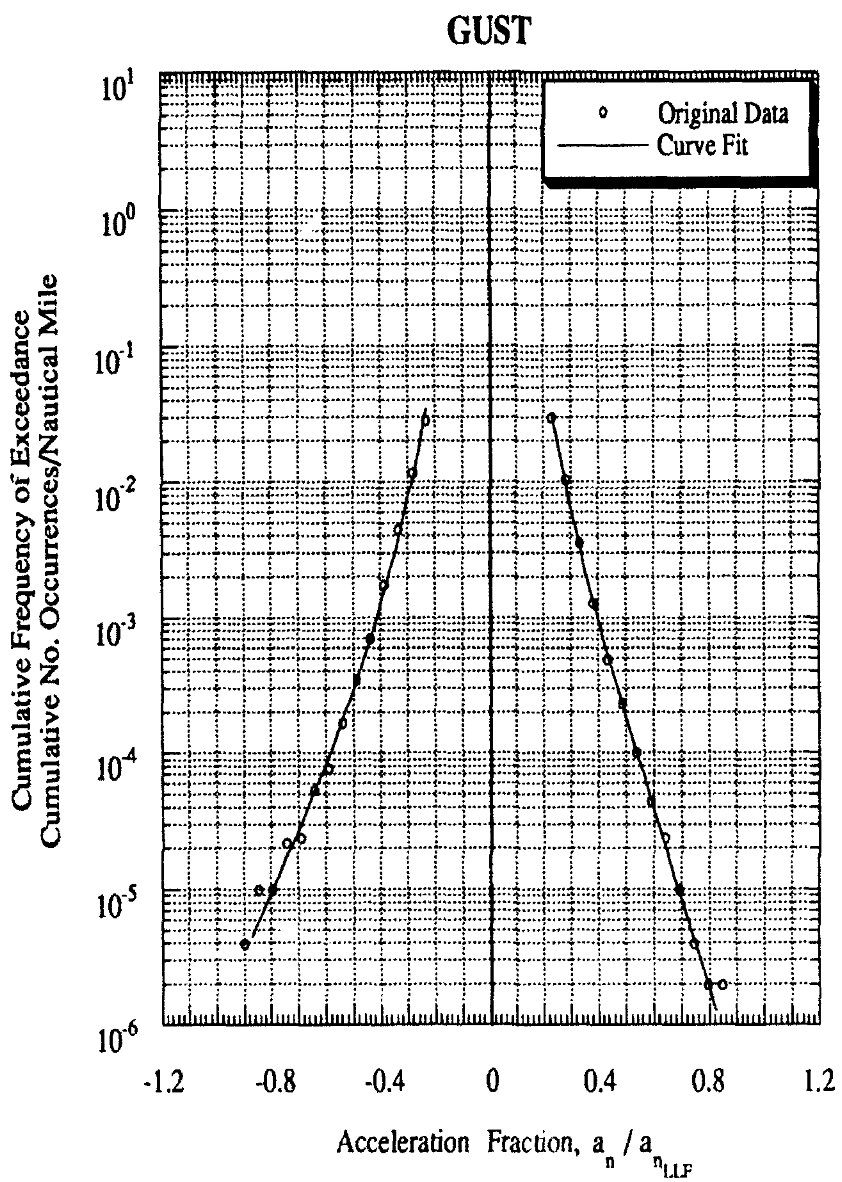
Curve fit for original data $(-0.750 < x < -0.231)$
$\log(y) = -5.052 - 0.822x^2 - 5.692\log(x)$
Curve fit for extrapolation $(-1.200 < x < -0.750)$
$\log(y) = -1.407 - 4.528x$

Curve fit for original data $(0.231 < x < 0.750)$
$\log(y) = -4.683 - 2.443x^2 - 5.191\log(x)$
Curve fit for extrapolation $(0.750 < x < 2.000)$
$\log(y) = -0.406 - 6.671x$

Curve fit for original data $(-0.400 < x < -0.194)$
$\log(y) = -3.960 - 14.813x^2 - 1.913\log(x)$
Curve fit for extrapolation $(-0.800 < x < -0.400)$
$\log(y) = 0.003 - 13.928x$

Curve fit for original data $(0.197 < x < 0.500)$
$\log(y) = -5.558 - 3.179x^2 - 4.263\log(x)$
Curve fit for extrapolation $(0.500 < x < 1.600)$
$\log(y) = -1.629 - 6.882x$

Figure C-70 Load Spectra for Airplane 40, Twin-Engine, General Usage



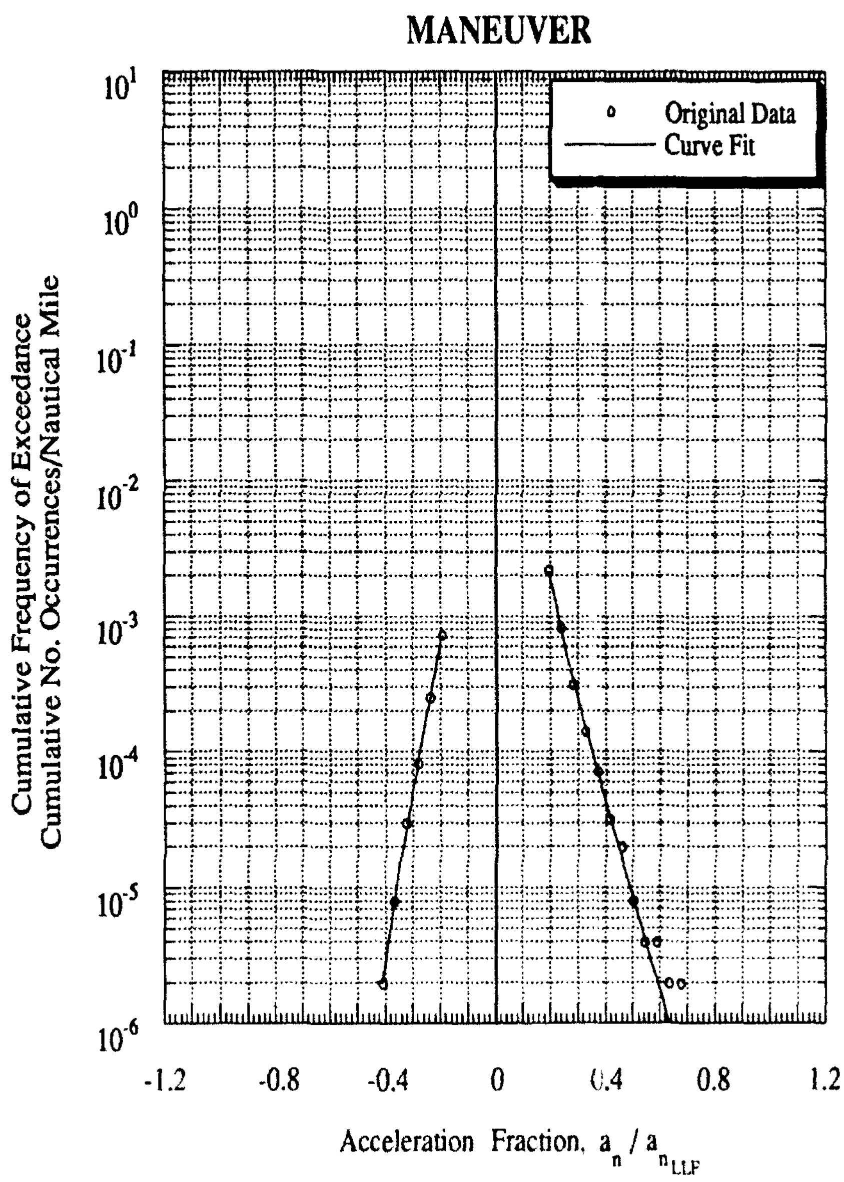


Table C-71 Tabulated Data for Airplane 255-203

Total Nautical Miles = 88458.34 Total Hours = 438.22

GUST negative: Acceleration Fraction	GUST negative: Cumulative Frequency of Exceedance	GUST positive: Acceleration Fraction	GUST positive: Cumulative Frequency of Exceedance	MANEUVER negative: Acceleration Fraction	MANEUVER negative: Cumulative Frequency of Exceedance	MANEUVER positive: Acceleration Fraction	MANEUVER positive: Cumulative Frequency of Exceedance
-0.250	0.0044864	0.250	0.0094217	-0.200	0.0017580	0.200	0.0089099
-0.300	0.0012991	0.300	0.0033801	-0.250	0.0003376	0.250	0.0016555
-0.350	0.0004856	0.350	0.0013652	-0.300	0.7806E-04	0.300	0.0002786
-0.400	0.0002209	0.400	0.0005979	-0.350	0.2011E-04	0.350	0.4088E-04
-0.450	0.0001177	0.450	0.0002771	-0.400	0.5378E-05	0.400	0.5553E-05
-0.500	0.7155E-04	0.500	0.0001337	-0.450	0.1438E-05		
-0.550	0.4872E-04	0.550	0.6637E-04				
-0.600	0.3665E-04	0.600	0.3360E-04				
		0.650	0.1723E-04				
		0.700	0.8882E-05				
		0.750	0.4577E-05				
		0.800	0.2359E-05				
		0.850	0.1216E-05				

NOTE: for curve fits x = |x|

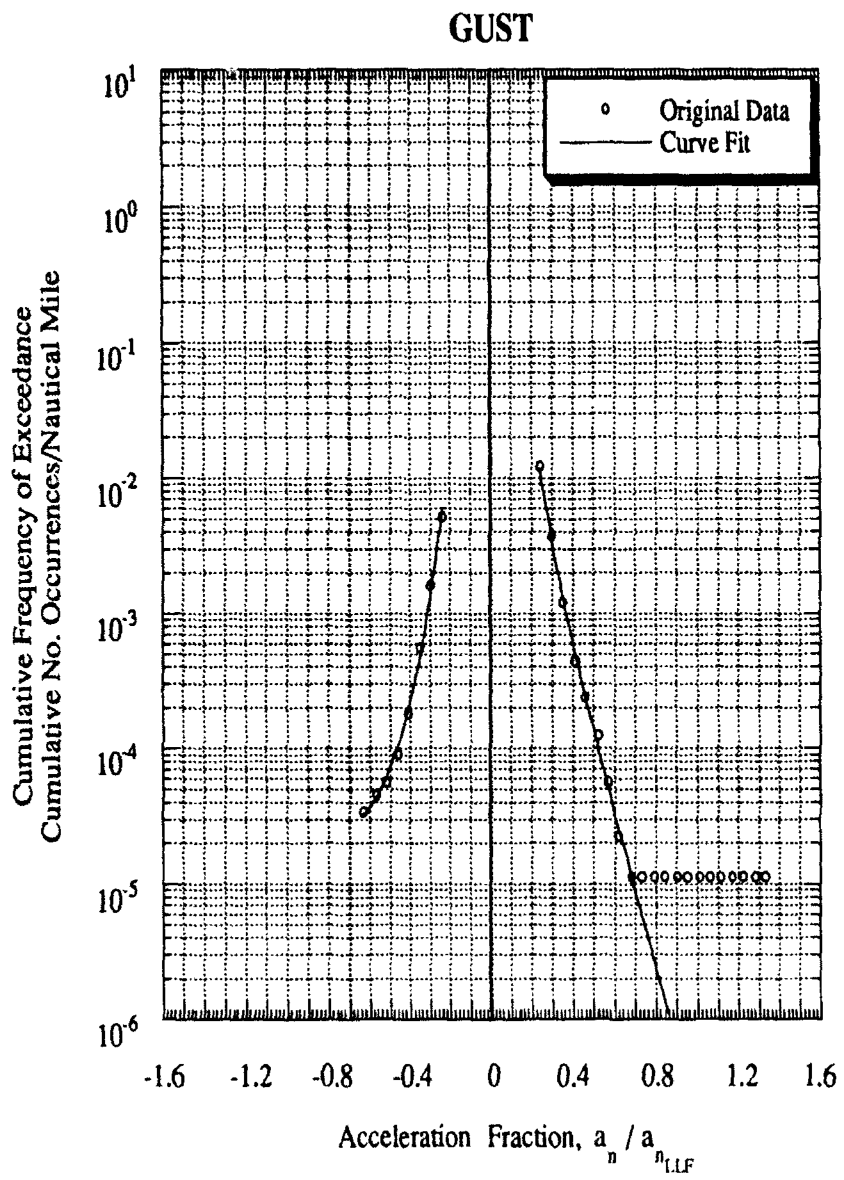
Curve fit for original data ($-0.600 < x < -0.240$)
$\log(y) = -7.256 + 3.003x^2 - 7.841\log(x)$
Curve fit for extrapolation ($-1.200 < x < -0.600$)
$\log(y) = -3.193 - 2.072x$

Curve fit for original data ($0.240 < x < 0.650$)
$\log(y) = -4.902 - 1.874x^2 - 4.972\log(x)$
Curve fit for extrapolation ($0.650 < x < 2.000$)
$\log(y) = -1.021 - 5.758x$

Curve fit for original data ($-0.350 < x < -0.200$)
$\log(y) = -6.803 - 5.541x^2 - 6.108\log(x)$
Curve fit for extrapolation ($-0.800 < x < -0.350$)
$\log(y) = -0.686 - 11.457x$

Curve fit for original data ($0.200 < x < 0.350$)
$\log(y) = -3.403 - 19.376x^2 - 3.044\log(x)$
Curve fit for extrapolation ($0.350 < x < 1.600$)
$\log(y) = 1.681 - 17.340x$

Figure C-71 Load Spectra for Airplane 255-203, Twin-Engine, General Usage



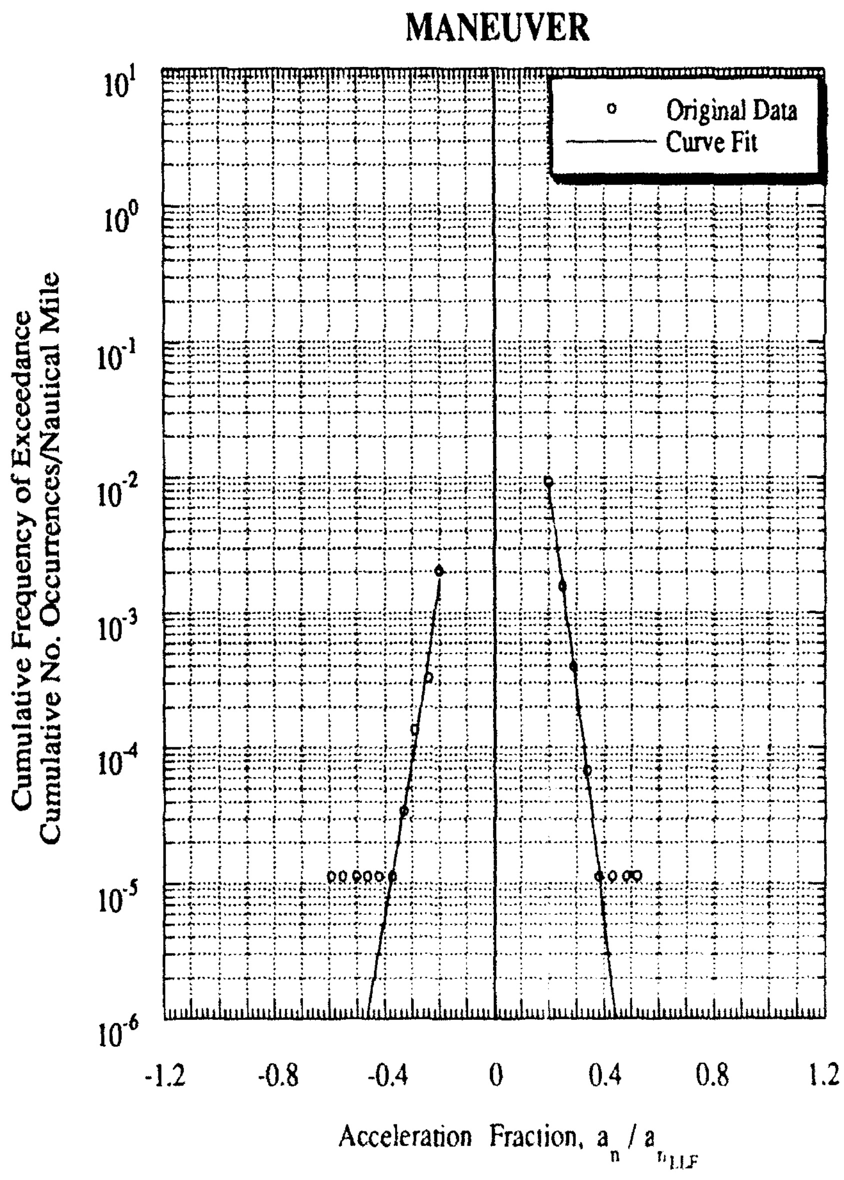


Table C-72 Tabulated Data for Airplane 310-110

Total Nautical Miles = 155074.7 Total Hours = 1155.77

GUST				MANEUVER			
negative		positive		negative		positive	
Acceleration Fraction	Cumulative Frequency of Exceedance	Acceleration Fraction	Cumulative Frequency of Exceedance	Acceleration Fraction	Cumulative Frequency of Exceedance	Acceleration Fraction	Cumulative Frequency of Exceedance
-0.200	0.0103298	0.200	0.0223185	-0.200	0.0219864	0.150	0.1490869
-0.250	0.0022081	0.250	0.0038241	-0.250	0.0049681	0.200	0.0520928
-0.300	0.0005603	0.300	0.0011075	-0.300	0.0012621	0.250	0.0211728
-0.350	0.0001570	0.350	0.0004527	-0.350	0.0003386	0.300	0.0093054
-0.400	0.4658E-04	0.400	0.0002345	-0.400	0.9241E-04	0.350	0.0042535
		0.450	0.0001436	-0.450	0.2504E-04	0.400	0.0019756
		0.500	0.9910E-04	-0.500	0.6723E-05	0.450	0.0009186
		0.550	0.7455E-04	-0.550	0.1805E-05	0.500	0.0004232
		0.600	0.5962E-04			0.550	0.0001918
		0.650	0.4973E-04			0.600	0.8501E-04
		0.700	0.4263E-04			0.650	0.3672E-04
		0.750	0.3712E-04			0.700	0.1540E-04
		0.800	0.3247E-04				
		0.850	0.2840E-04				
		0.900	0.2485E-04				
		0.950	0.2173E-04				

NOTE: for curve fits $x = |x|$

Curve fit for original data ($-0.400 < x < -0.190$)
$\log(y) = -5.751 - 5.278x^2 - 5.689\log(x)$
Curve fit for extrapolation ($-1.200 < x < -0.400$)
$\log(y) = -0.172 - 10.399x$

Curve fit for original data ($0.190 < x < 0.750$)
$\log(y) = -14.33 + 14.56x - 4.975x^2 - 14.26\log(x)$
Curve fit for extrapolation ($0.750 < x < 2.000$)
$\log(y) = -3.559 - 1.162x$

Curve fit for original data ($-0.450 < x < -0.180$)
$\log(y) = -4.824 - 7.382x^2 - 4.952\log(x)$
Curve fit for extrapolation ($-0.800 < x < -0.450$)
$\log(y) = 0.539 - 11.423x$

Curve fit for original data ($0.160 < x < 0.700$)
$\log(y) = -3.270 - 4.121x^2 - 3.078\log(x)$
Curve fit for extrapolation ($0.700 < x < 1.600$)
$\log(y) = 0.563 - 7.679x$

Figure C-72 Load Spectra for Airplane 310-110, Twin-Engine, General Usage

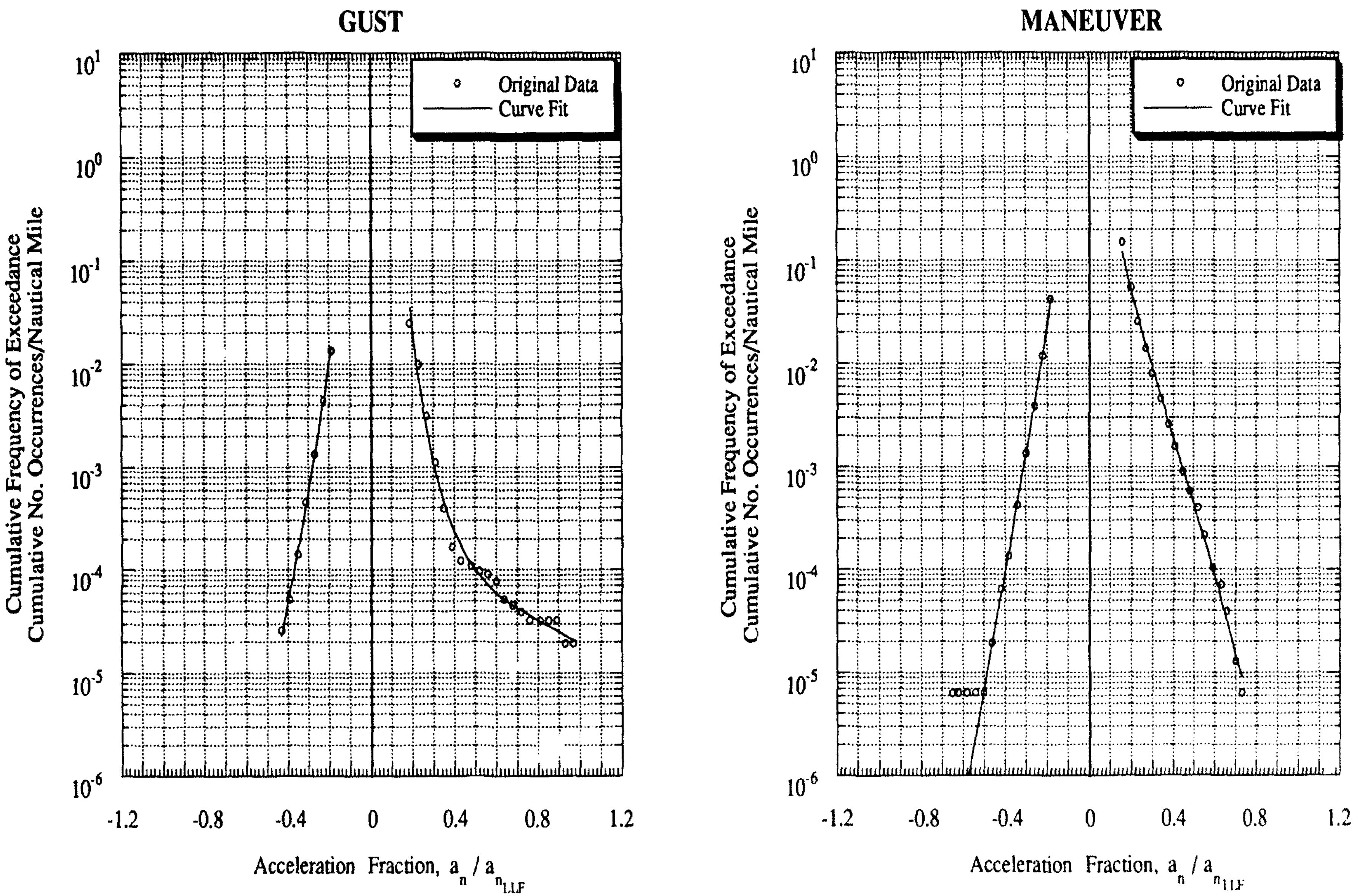


Table C-73 Tabulated Data for Airplane 4[1]

Total Nautical Miles = 20202 Total Hours = 134

GUST				MANEUVER			
negative		positive		negative		positive	
Acceleration Fraction	Cumulative Frequency of Exceedance	Acceleration Fraction	Cumulative Frequency of Exceedance	Acceleration Fraction	Cumulative Frequency of Exceedance	Acceleration Fraction	Cumulative Frequency of Exceedance
-0.150	0.0375531	0.150	0.0362371	-0.200	0.0048133	0.150	0.0541202
-0.200	0.0130361	0.200	0.0160957	-0.250	0.0007732	0.200	0.0256594
-0.250	0.0041127	0.250	0.0047085			0.250	0.0132956
-0.300	0.0011405	0.300	0.0009348			0.300	0.0071703
-0.350	0.0002731	0.350	0.0001280			0.350	0.0039213
-0.400	0.5585E-04					0.400	0.0021411
						0.450	0.0011556
						0.500	0.0006123
						0.550	0.0003169
						0.600	0.0001619
						0.650	0.8274E-04

NOTE: for curve fits x = |x|

Curve fit for original data $(-0.400 < x < -0.173)$
$\log(y) = -2.221 - 16.201x^2 - 1.409\log(x)$
Curve fit for extrapolation $(-1.500 < x < -0.400)$
$\log(y) = 1.543 - 14.490x$

Curve fit for original data $(0.173 < x < 0.350)$
$\log(y) = 0.259 - 29.180x^2 + 1.266\log(x)$
Curve fit for extrapolation $(0.350 < x < 1.400)$
$\log(y) = 2.706 - 18.855x$

Curve fit for original data $(-0.250 < x < -0.179)$
$\log(y) = -5.324 - 13.455x^2 - 5.071\log(x)$
Curve fit for extrapolation $(-0.800 < x < -0.250)$
$\log(y) = 0.772 - 15.537x$

Curve fit for original data $(0.161 < x < 0.550)$
$\log(y) = -2.877 - 3.825x^2 - 2.058\log(x)$
Curve fit for extrapolation $(0.550 < x < 1.500)$
$\log(y) = -0.291 - 5.832x$

Figure C-73 Load Spectra for Airplane 4[1], Twin-Engine, Special Usage

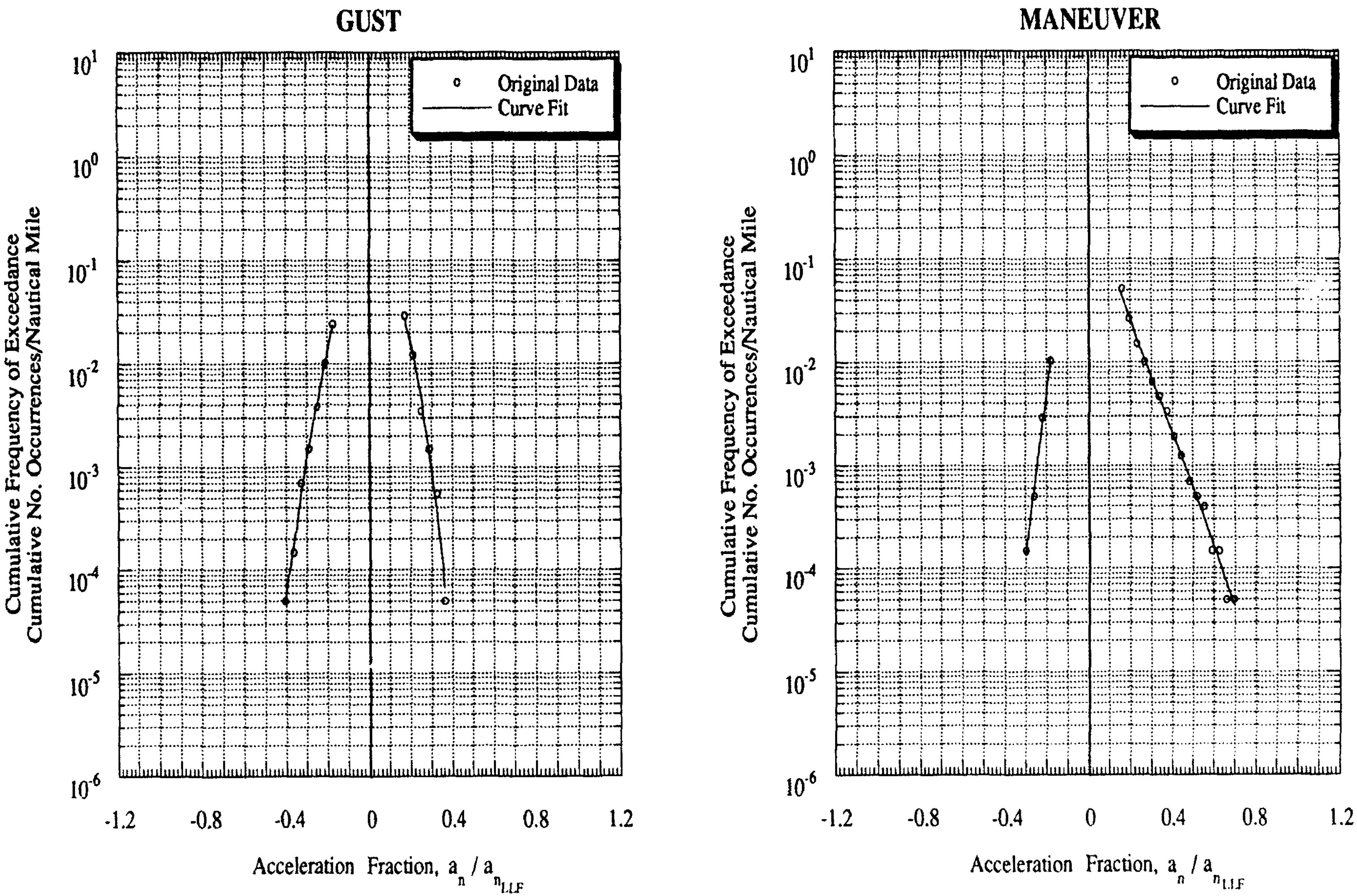


Table C-74 Tabulated Data for Airplane 25

Total Nautical Miles = 37921 Total Hours = 246

GUST negative		GUST positive		MANEUVER negative		MANEUVER positive	
Acceleration Fraction	Cumulative Frequency of Exceedance	Acceleration Fraction	Cumulative Frequency of Exceedance	Acceleration Fraction	Cumulative Frequency of Exceedance	Acceleration Fraction	Cumulative Frequency of Exceedance
-0.200	0.3779985	0.200	0.3734160	-0.100	0.1003894	0.150	0.2290210
-0.250	0.1216147	0.250	0.1392042	-0.150	0.0052014	0.200	0.1453332
-0.300	0.0471762	0.300	0.0595912	-0.200	0.0006498	0.250	0.0847099
-0.350	0.0207500	0.350	0.0278644	-0.250	0.0001322	0.300	0.0450224
-0.400	0.0099757	0.400	0.0138129	-0.300	0.3209E-04	0.350	0.0217354
-0.450	0.0051195	0.450	0.0071207			0.400	0.0095092
-0.500	0.0027596	0.500	0.0037674			0.450	0.0037646
-0.550	0.0015446	0.550	0.0020266			0.500	0.0013472
-0.600	0.0008901	0.600	0.0011008			0.550	0.0004355
-0.650	0.0005247	0.650	0.0006006			0.600	0.0001271
-0.700	0.0003148	0.700	0.0003278			0.650	0.3524E-04
-0.750	0.0001914	0.750	0.0001784			0.700	0.9771E-05
-0.800	0.0001176	0.800	0.9652E-04				
-0.850	0.7262E-04	0.850	0.5205E-04				
-0.900	0.4482E-04	0.900	0.2807E-04				
-0.950	0.2766E-04	0.950	0.1514E-04				
-1.000	0.1708E-04	1.000	0.8163E-05				
-1.050	0.1054E-04	1.050	0.4402E-05				
-1.100	0.6505E-05	1.100	0.2374E-05				
-1.150	0.4015E-05	1.150	0.1280E-05				
-1.200	0.2478E-05						
-1.250	0.1530E-05						

NOTE: for curve fits x = |x|

Curve fit for original data (-0.800 < x < -0.205)
$\log(y) = -3.778 - 0.972x^2 - 4.856\log(x)$
Curve fit for extrapolation (-1.500 < x < -0.800)
$\log(y) = -0.577 - 4.191x$

Curve fit for original data (0.205 < x < 0.800)
$\log(y) = -3.112 - 2.010x^2 - 3.955\log(x)$
Curve fit for extrapolation (0.800 < x < 1.400)
$\log(y) = 0.276 - 5.364x$

Curve fit for original data (-0.250 < x < -0.113)
$\log(y) = -8.381 + 1.020x^2 - 7.373\log(x)$
Curve fit for extrapolation (-0.800 < x < -0.250)
$\log(y) = -0.804 - 12.298x$

Curve fit for original data (0.141 < x < 0.600)
$\log(y) = -0.688 - 9.100x^2 - 0.306\log(x)$
Curve fit for extrapolation (0.600 < x < 1.500)
$\log(y) = 2.789 - 11.142x$

Figure C-74 Load Spectra for Airplane 25, Twin-Engine, Special Usage

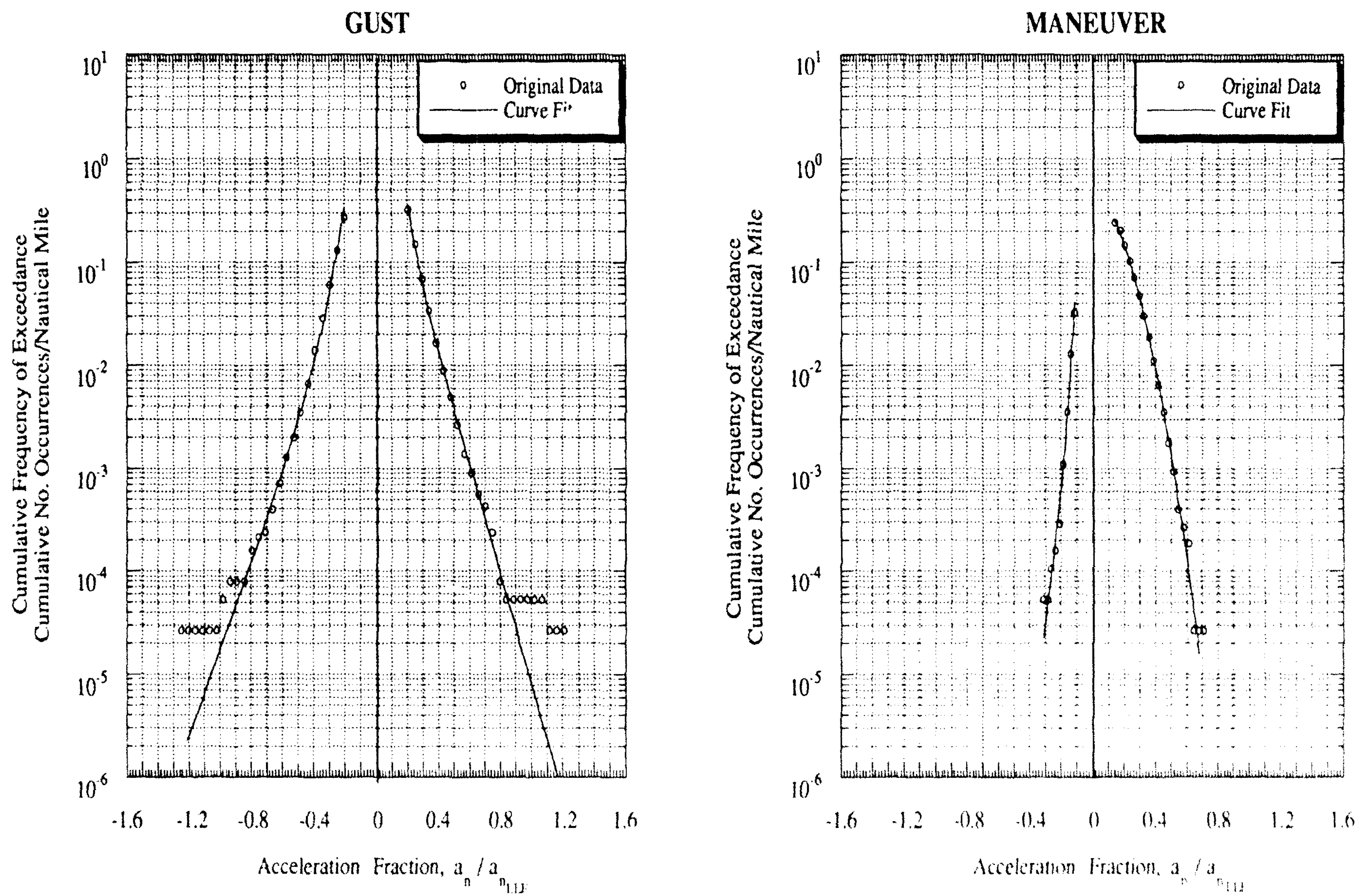


Table C-75 Tabulated Data for Airplane 26

Total Nautical Miles = 126142 Total Hours = 901

GUST				MANEUVER			
negative		positive		negative		positive	
Acceleration Fraction	Cumulative Frequency of Exceedance	Acceleration Fraction	Cumulative Frequency of Exceedance	Acceleration Fraction	Cumulative Frequency of Exceedance	Acceleration Fraction	Cumulative Frequency of Exceedance
-0.200	0.1150681	0.200	0.2188777	-0.200	0.0049927	0.150	0.0357037
-0.250	0.0292962	0.250	0.0516867	-0.250	0.0007218	0.200	0.0094040
-0.300	0.0074861	0.300	0.0136458	-0.300	0.0001132	0.250	0.0027369
-0.350	0.0018390	0.350	0.0037914	-0.350	0.1794E-04	0.300	0.0008143
-0.400	0.0004233	0.400	0.0010693			0.350	0.0002376
-0.450	0.8979E-04	0.450	0.0002991			0.400	0.6634E-04
		0.500	0.8164E-04			0.450	0.1744E-04
		0.550	0.2151E-04				
		0.600	0.5549E-05				
		0.650	0.1432E-05				

NOTE: for curve fits x = |x|

Curve fit for original data (-0.450<x<-0.208)
$\log(y) = -2.848 - 11.749x^2 - 3.403\log(x)$
Curve fit for extrapolation (-1.500<x<-0.450)
$\log(y) = 2.190 - 13.858x$

Curve fit for original data (0.208<x<0.550)
$\log(y) = -3.711 - 7.265x^2 - 4.781\log(x)$
Curve fit for extrapolation (0.550<x<1.400)
$\log(y) = 1.804 - 11.767x$

Curve fit for original data (-0.350<x<-0.179)
$\log(y) = -5.736 - 12.970x^2 - 5.655\log(x)$
Curve fit for extrapolation (-0.800<x<-0.350)
$\log(y) = 0.888 - 16.096x$

Curve fit for original data (0.161<x<0.450)
$\log(y) = -3.930 - 9.706x^2 - 3.278\log(x)$
Curve fit for extrapolation (0.450<x<1.500)
$\log(y) = 0.596 - 11.899x$

Figure C-75 Load Spectra for Airplane 26, Twin-Engine, Special Usage

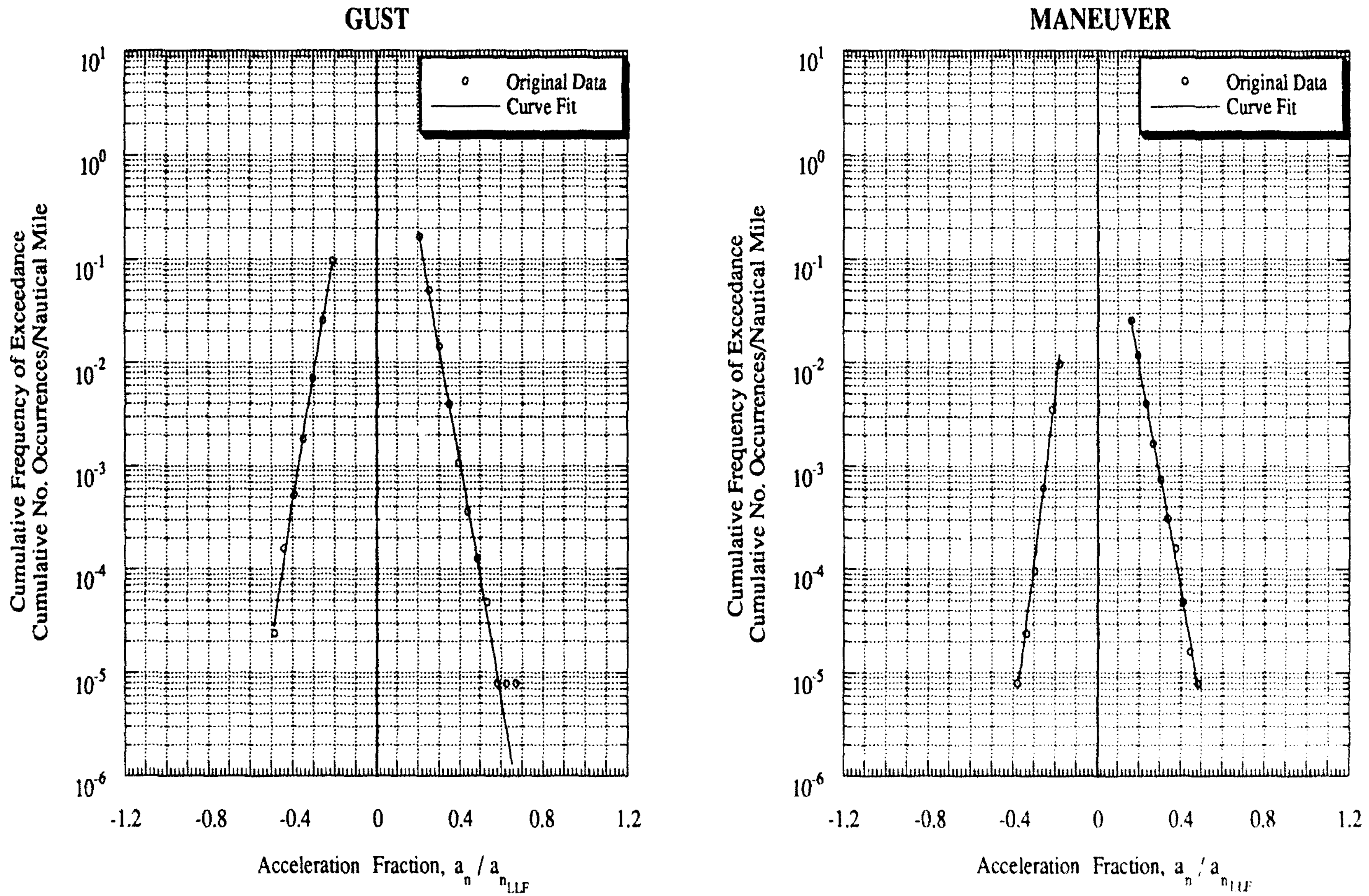


Table C-76 Tabulated Data for Airplane 3

Total Nautical Miles = 39856 Total Hours = 213

GUST				MANEUVER			
negative		positive		negative		positive	
Acceleration Fraction	Cumulative Frequency of Exceedance	Acceleration Fraction	Cumulative Frequency of Exceedance	Acceleration Fraction	Cumulative Frequency of Exceedance	Acceleration Fraction	Cumulative Frequency of Exceedance
-0.200	0.0164582	0.200	0.0179797	-0.150	0.0011361	0.200	0.0023140
-0.250	0.0049480	0.250	0.0046380	-0.200	0.3548E-04	0.250	0.0010201
-0.300	0.0017621	0.300	0.0015184			0.300	0.0005023
-0.350	0.0006993	0.350	0.0005850			0.350	0.0002652
-0.400	0.0002982	0.400	0.0002535			0.400	0.0001465
-0.450	0.0001334	0.450	0.0001201			0.450	0.8226E-04
-0.500	0.6168E-04	0.500	0.6093E-04			0.500	0.4621E-04
-0.550	0.2885E-04	0.550	0.3184E-04			0.550	0.2595E-04
						0.600	0.1458E-04
						0.650	0.8188E-05
						0.700	0.4599E-05

NOTE: for curve fits $x = |x|$

Curve fit for original data ($-0.500 < x < -0.214$)
$\log(y) = -5.062 - 2.406x^2 - 4.827\log(x)$
Curve fit for extrapolation ($-1.200 < x < -0.500$)
$\log(y) = -0.910 - 6.599x$

Curve fit for original data ($0.214 < x < 0.500$)
$\log(y) = -5.897 - 0.456x^2 - 5.966\log(x)$
Curve fit for extrapolation ($0.500 < x < 1.000$)
$\log(y) = -1.396 - 5.638x$

Curve fit for original data ($-0.200 < x < -0.168$)
$\log(y) = 1.572 - 30.108x$
Curve fit for extrapolation ($-0.800 < x < -0.200$)
$\log(y) = 1.572 - 30.108x$

Curve fit for original data ($0.188 < x < 0.400$)
$\log(y) = -4.823 - 1.870x^2 - 3.236\log(x)$
Curve fit for extrapolation ($0.400 < x < 1.000$)
$\log(y) = -1.830 - 5.010x$

Figure C-76 Load Spectra for Airplane 3, Pressurized, General Usage

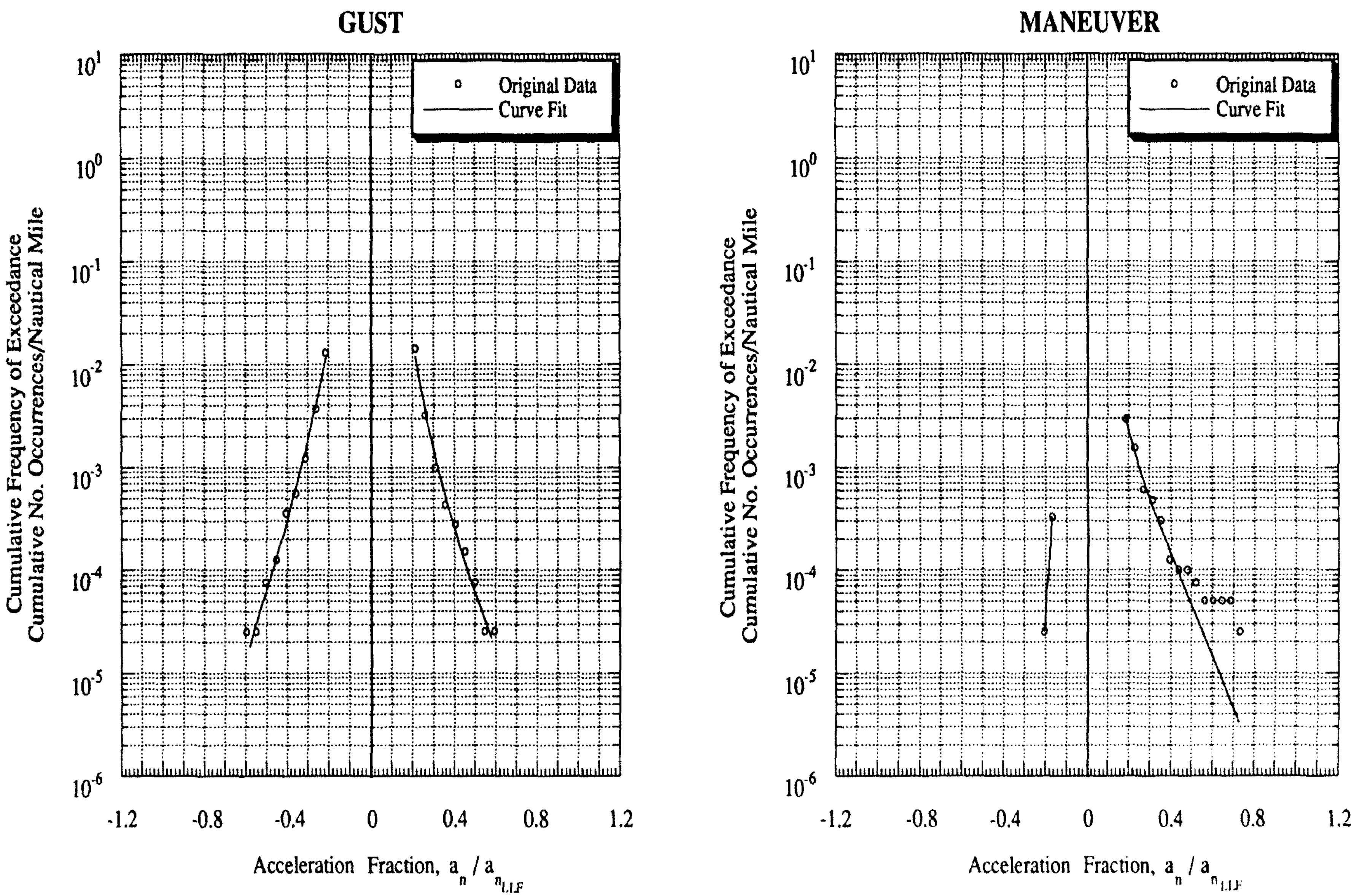


Table C-77 Tabulated Data for Airplane 3[1]

Total Nautical Miles = 281300 Total Hours = 1427

GUST				MANEUVER			
negative		positive		negative		positive	
Acceleration Fraction	Cumulative Frequency of Exceedance	Acceleration Fraction	Cumulative Frequency of Exceedance	Acceleration Fraction	Cumulative Frequency of Exceedance	Acceleration Fraction	Cumulative Frequency of Exceedance
-0.200	0.0089890	0.200	0.0128137	-0.150	0.0003842	0.200	0.0005855
-0.250	0.0032309	0.250	0.0032599	-0.200	0.6932E-04	0.250	0.0001672
-0.300	0.0012301	0.300	0.0010487	-0.250	0.2004E-04	0.300	0.5488E-04
-0.350	0.0004767	0.350	0.0003956	-0.300	0.7949E-05	0.350	0.1954E-04
-0.400	0.0001836	0.400	0.0001673	-0.350	0.3981E-05	0.400	0.7283E-05
-0.450	0.6920E-04	0.450	0.7703E-04				
-0.500	0.2526E-04	0.500	0.3787E-04				
-0.550	0.8867E-05	0.550	0.1960E-04				
		0.600	0.1056E-04				

NOTE: for curve fits x = |x|

Curve fit for original data ($-0.550 < x < -0.214$)
$\log(y) = -4.002 - 6.177x^2 - 3.151\log(x)$
Curve fit for extrapolation ($-1.200 < x < -0.550$)
$\log(y) = 0.053 - 9.283x$

Curve fit for original data ($0.214 < x < 0.600$)
$\log(y) = -6.028 - 0.751x^2 - 5.960\log(x)$
Curve fit for extrapolation ($0.600 < x < 1.000$)
$\log(y) = -1.847 - 5.215x$

Curve fit for original data ($-0.350 < x < -0.168$)
$\log(y) = -8.906 + 4.248x^2 - 6.547\log(x)$
Curve fit for extrapolation ($-0.800 < x < -0.350$)
$\log(y) = -3.597 - 5.151x$

Curve fit for original data ($0.188 < x < 0.400$)
$\log(y) = -6.294 - 4.276x^2 - 4.625\log(x)$
Curve fit for extrapolation ($0.400 < x < 1.000$)
$\log(y) = -1.761 - 8.442x$

Figure C-77 Load Spectra for Airplane 3[1], Pressurized, General Usage

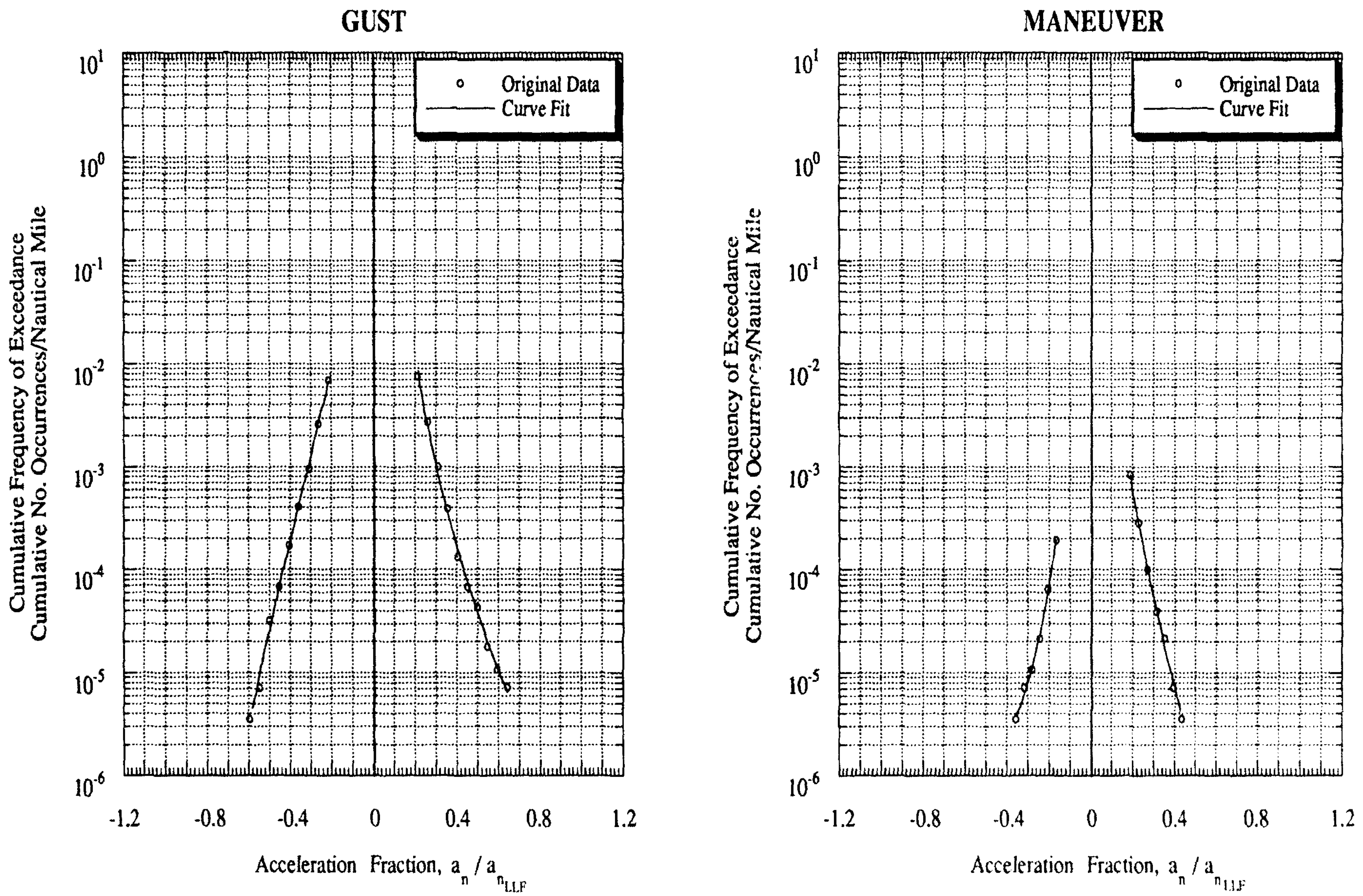


Table C-78 Tabulated Data for Airplane 1

Total Nautical Miles = 219656   Total Hours = 578

GUST				MANEUVER			
negative		positive		negative		positive	
Acceleration Fraction	Cumulative Frequency of Exceedance	Acceleration Fraction	Cumulative Frequency of Exceedance	Acceleration Fraction	Cumulative Frequency of Exceedance	Acceleration Fraction	Cumulative Frequency of Exceedance
-0.050	0.0659732	0.050	0.0555101	-0.150	0.0019597	0.150	0.0123351
-0.100	0.0036885	0.100	0.0046206	-0.200	0.0003224	0.200	0.0038257
-0.150	0.0006295	0.150	0.0008992	-0.250	0.7517E-04	0.250	0.0013406
-0.200	0.0001647	0.200	0.0002318	-0.300	0.2161E-04	0.300	0.0004930
-0.250	0.5328E-04	0.250	0.6626E-04	-0.350	0.7105E-05	0.350	0.0001829
-0.300	0.1934E-04	0.300	0.1940E-04	-0.400	0.2458E-05	0.400	0.6690E-04
-0.350	0.7296E-05					0.450	0.2375E-04

NOTE: for curve fits $x = |x|$

Gust, negative

Curve fit for original data ($-0.300 < x < -0.074$)
$\log(y) = -6.443 - 4.334x^2 - 4.053\log(x)$
Curve fit for extrapolation ($-0.368 < x < -0.300$)
$\log(y) = -2.173 - 8.467x$

Gust, positive

Curve fit for original data ($0.074 < x < 0.300$)
$\log(y) = -5.581 - 9.773x^2 - 3.343\log(x)$

Maneuver, negative

Curve fit for original data ($-0.350 < x < -0.125$)
$\log(y) = -7.501 - 2.725x^2 - 5.892\log(x)$
Curve fit for extrapolation ($-0.525 < x < -0.350$)
$\log(y) = -1.922 - 9.219x$

Maneuver, positive

Curve fit for original data ($0.167 < x < 0.450$)
$\log(y) = -4.319 - 6.838x^2 - 3.112\log(x)$

Figure C-78 Load Spectra for Airplane 1, Twin-Engine, Executive Jet

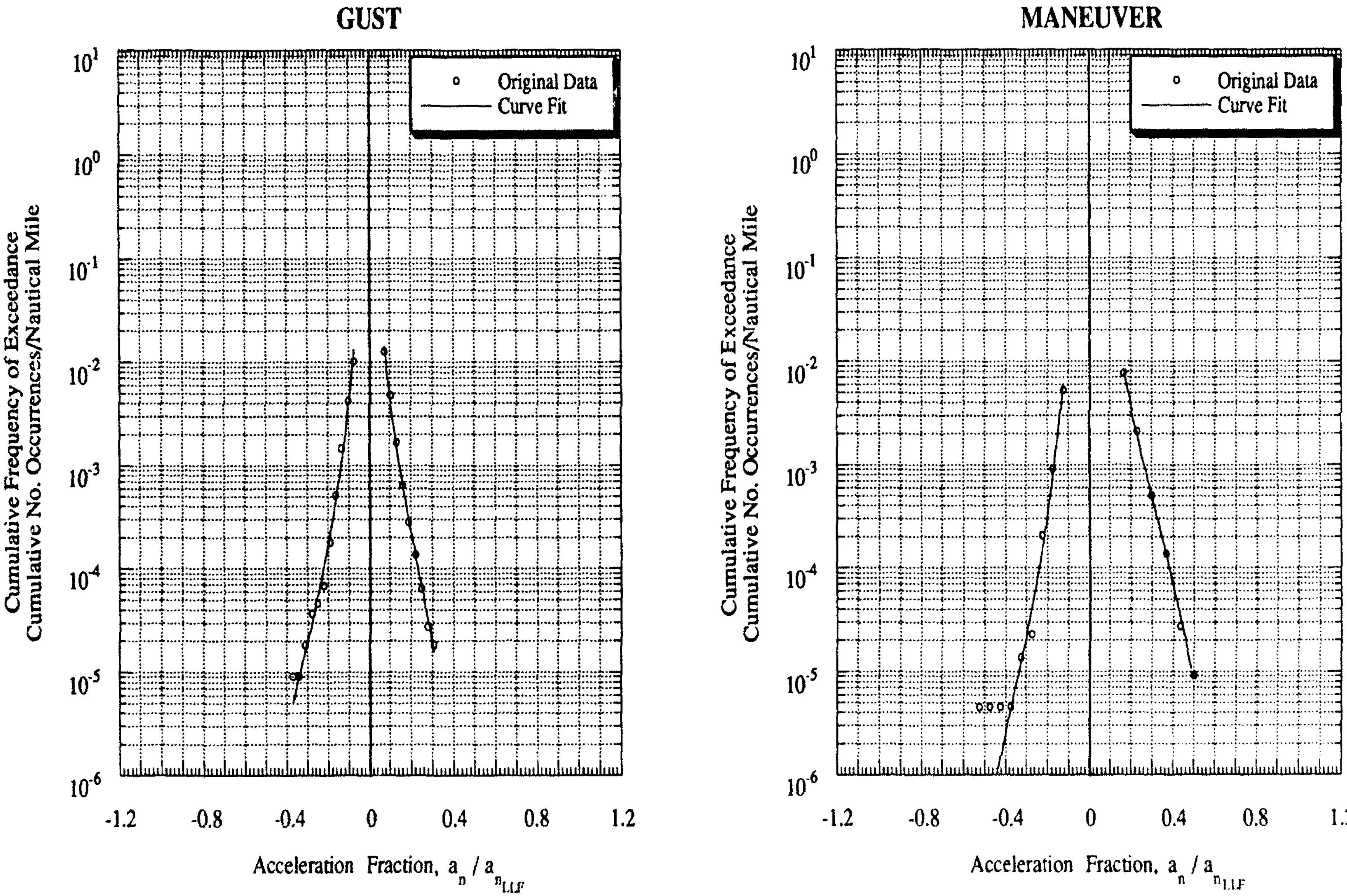


Table C-79 Tabulated Data for Airplane 1[1]

Total Nautical Miles = 250447 Total Hours = 760

GUST				MANEUVER			
negative		positive		negative		positive	
Acceleration Fraction	Cumulative Frequency of Exceedance	Acceleration Fraction	Cumulative Frequency of Exceedance	Acceleration Fraction	Cumulative Frequency of Exceedance	Acceleration Fraction	Cumulative Frequency of Exceedance
-0.050	0.1217939	0.050	0.0969203	-0.150	0.0015547	0.150	0.0097422
-0.100	0.0029055	0.100	0.0036172	-0.200	0.0003974	0.200	0.0048404
-0.150	0.0002775	0.150	0.0003907	-0.250	0.0001112	0.250	0.0027462
-0.200	0.4405E-04	0.200	0.5841E-04	-0.300	0.3153E-04	0.300	0.0016860
-0.250	0.8831E-05	0.250	0.9594E-05	-0.350	0.8685E-05	0.350	0.0010885
						0.400	0.0007264
						0.450	0.0004956
						0.500	0.0003431
						0.550	0.0002398
						0.600	0.0001684
						0.650	0.0001185
						0.700	0.8344E-04
						0.750	0.5861E-04
						0.800	0.4103E-04
						0.850	0.2859E-04
						0.900	0.1980E-04
						0.950	0.1363E-04

NOTE: for curve fits $x = |x|$

Curve fit for original data $(-0.250 < x < -0.074)$
$\log(y) = -7.621 - 8.748x^2 - 5.172\log(x)$

Curve fit for original data $(0.074 < x < 0.250)$
$\log(y) = -6.621 - 16.170x^2 - 4.341\log(x)$

Curve fit for original data $(-0.350 < x < -0.125)$
$\log(y) = -5.269 - 10.486x^2 - 3.273\log(x)$

Curve fit for original data $(0.167 < x < 0.950)$
$\log(y) = -3.852 - 1.179x^2 - 2.266\log(x)$

Figure C-79 Load Spectra for Airplane 1[1], Twin-Engine, Executive Jet

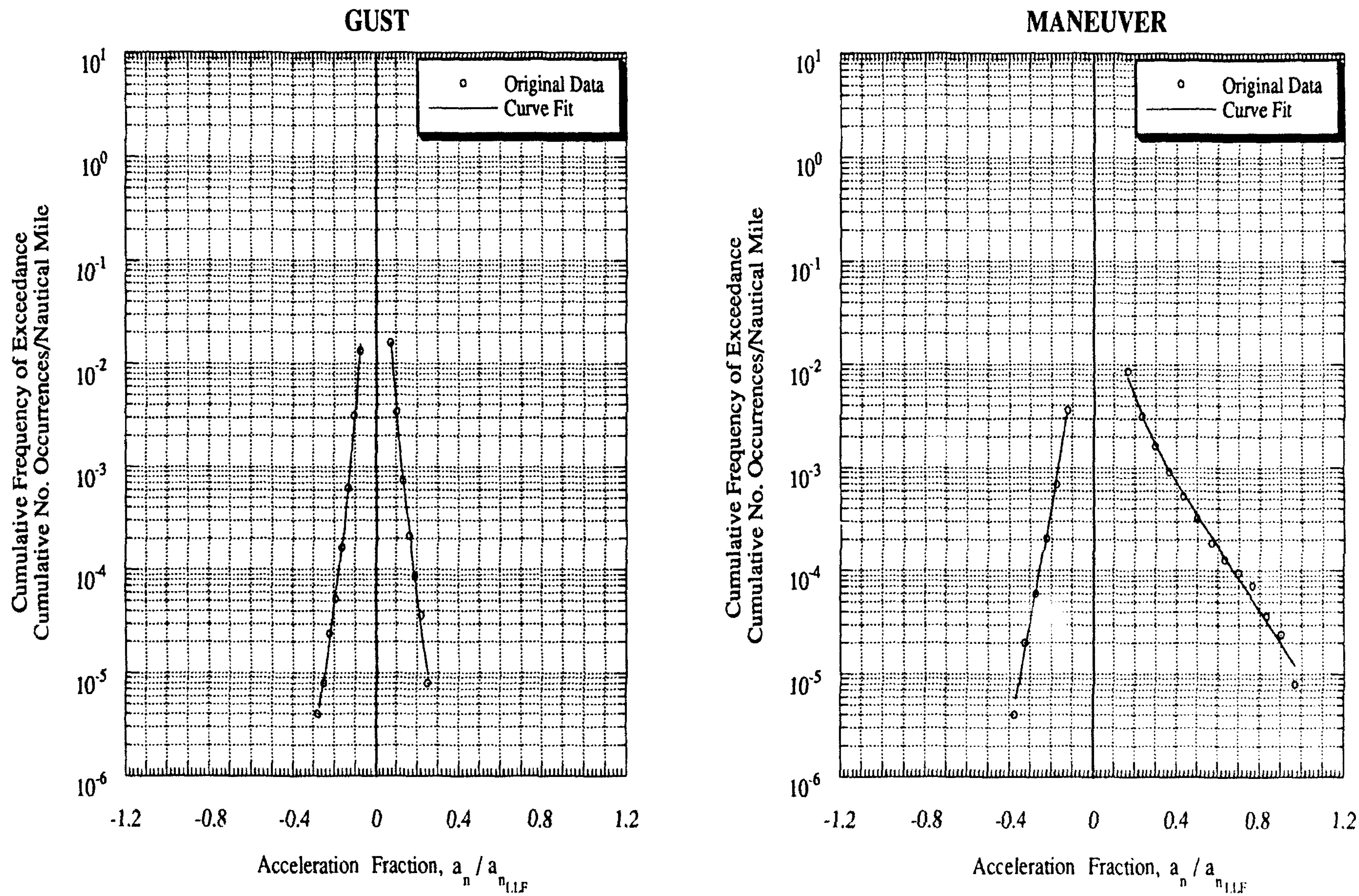


Table C-80 Tabulated Data for Airplane 1[2]

Total Nautical Miles = 88624 Total Hours = 244

GUST				MANEUVER			
negative		positive		negative		positive	
Acceleration Fraction	Cumulative Frequency of Exceedance	Acceleration Fraction	Cumulative Frequency of Exceedance	Acceleration Fraction	Cumulative Frequency of Exceedance	Acceleration Fraction	Cumulative Frequency of Exceedance
-0.050	0.0739278	0.050	0.1610174	-0.150	0.0013219	0.150	0.0077819
-0.100	0.0036598	0.100	0.0027947	-0.200	0.0003856	0.200	0.0033124
-0.150	0.0001894	0.150	0.0001651	-0.250	0.0001048	0.250	0.0016947
				-0.300	0.2535E-04	0.300	0.0009725
				-0.350	0.5733E-05	0.350	0.0006033
				-0.400	0.1297E-05	0.400	0.0003957
						0.450	0.0002706
						0.500	0.0001911
						0.550	0.0001383
						0.600	0.0001022
						0.650	0.7667E-04
						0.700	0.5829E-04
						0.750	0.4479E-04
						0.800	0.3458E-04
						0.850	0.2670E-04

NOTE: for curve fits $x = |x|$

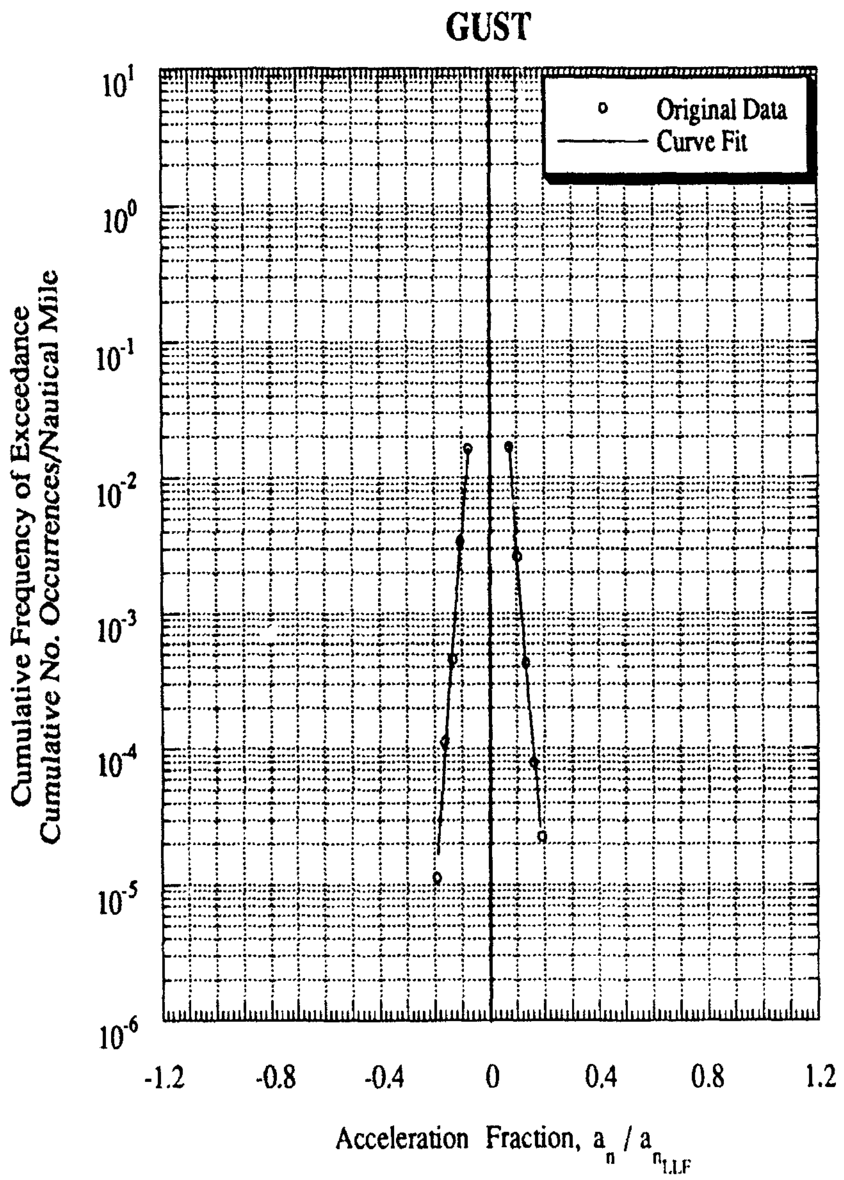
Curve fit for original data $(-0.150 < x < -0.074)$
$\log(y) = -4.525 - 64.394x^2 - 2.732\log(x)$

Curve fit for original data $(0.074 < x < 0.150)$
$\log(y) = -7.546 - 24.512x^2 - 5.238\log(x)$

Curve fit for original data $(-0.300 < x < -0.125)$
$\log(y) = -4.077 - 16.898x^2 - 1.915\log(x)$
Curve fit for extrapolation $(-0.425 < x < -0.300)$
$\log(y) = -0.723 - 12.912x$

Curve fit for original data $(0.167 < x < 0.750)$
$\log(y) = -4.504 - 0.372x^2 - 2.917\log(x)$
Curve fit for extrapolation $(0.750 < x < 0.900)$
$\log(y) = -2.663 - 2.248x$

Figure C-80 Load Spectra for Airplane 1[2], Twin-Engine, Executive Jet



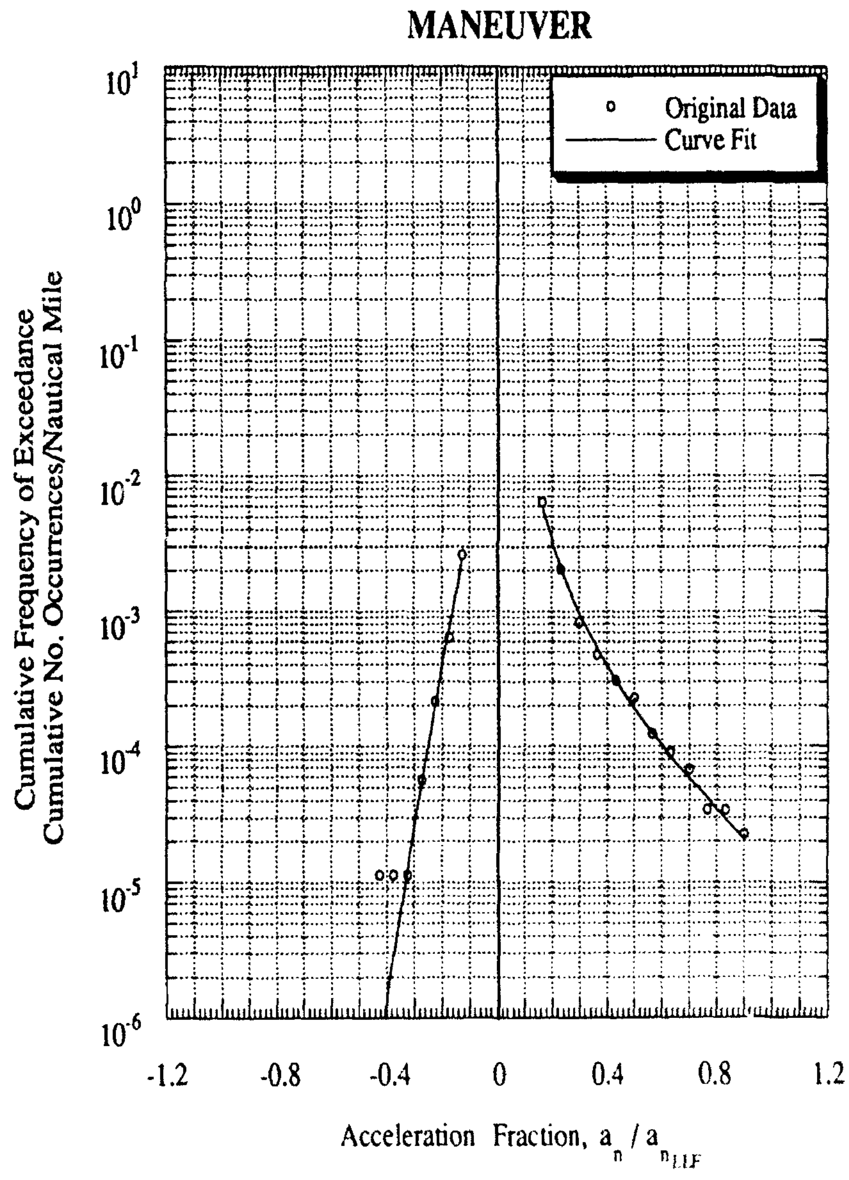


Table C-81 Tabulated Data for Airplane 1[3]

Total Nautical Miles = 15338 Total Hours = 41

GUST				MANEUVER			
negative		positive		negative		positive	
Acceleration Fraction	Cumulative Frequency of Exceedance	Acceleration Fraction	Cumulative Frequency of Exceedance	Acceleration Fraction	Cumulative Frequency of Exceedance	Acceleration Fraction	Cumulative Frequency of Exceedance
-0.050	0.2213605	0.050	0.1139650	-0.150	0.0023040	0.150	0.0143898
-0.100	0.0183266	0.100	0.0208763	-0.200	0.0006177	0.200	0.0081882
-0.150	0.0013916	0.150	0.0013809	-0.250	0.0001550	0.250	0.0050313
						0.300	0.0032123
						0.350	0.0020879
						0.400	0.0013647
						0.450	0.0008900
						0.500	0.0005759
						0.550	0.0003684
						0.600	0.0002323
						0.650	0.0001441
						0.700	0.8858E-04
						0.750	0.5446E-04
						0.800	0.3348E-04

NOTE: for curve fits $x = |x|$

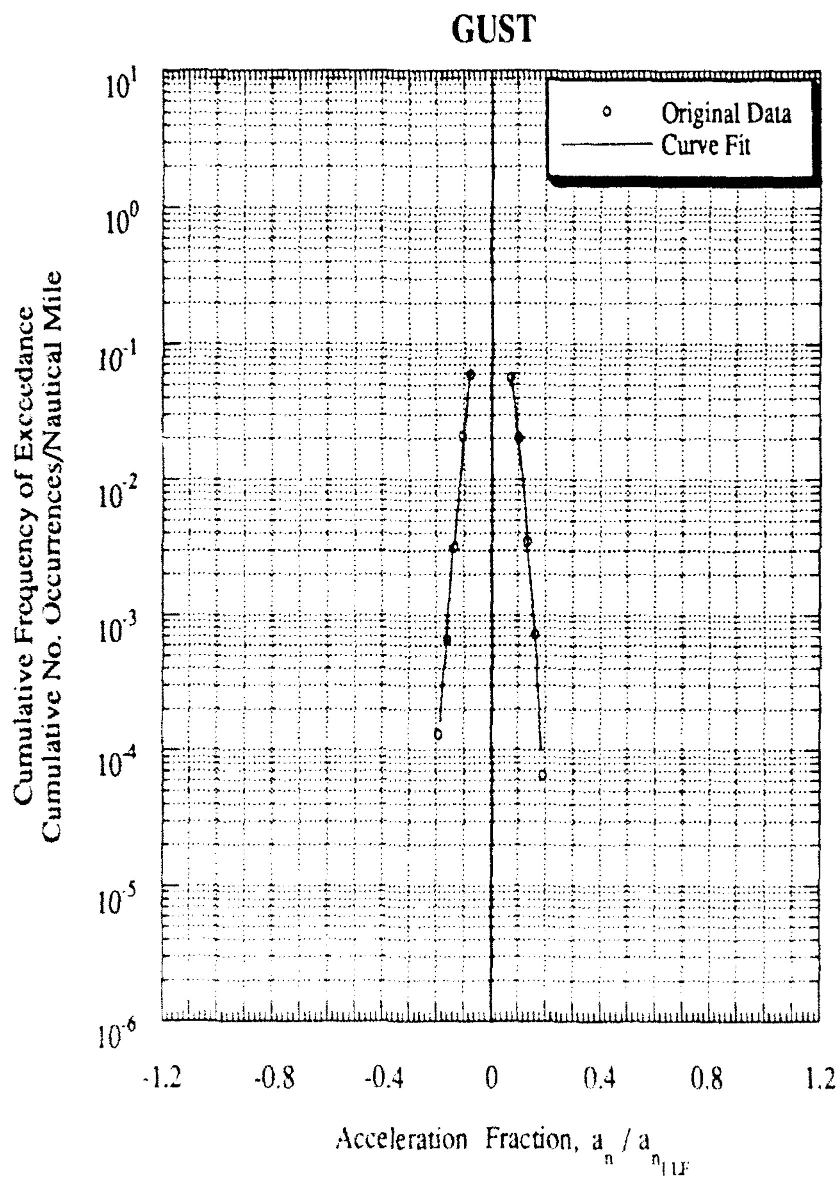
Curve fit for original data ($-0.150 < x < -0.074$)
$\log(y) = -3.237 - 59.985x^2 - 2.100\log(x)$

Curve fit for original data ($0.074 < x < 0.150$)
$\log(y) = -0.909 - 92.237x^2 - 0.151\log(x)$

Curve fit for original data ($-0.250 < x < -0.125$)
$\log(y) = -3.982 - 17.586x^2 - 2.113\log(x)$

Curve fit for original data ($0.167 < x < 0.650$)
$\log(y) = -3.123 - 2.417x^2 - 1.621\log(x)$
Curve fit for extrapolation ($0.650 < x < 0.833$)
$\log(y) = -1.095 - 4.226x$

Figure C-81 Load Spectra for Airplane 1[3], Twin-Engine, Executive Jet



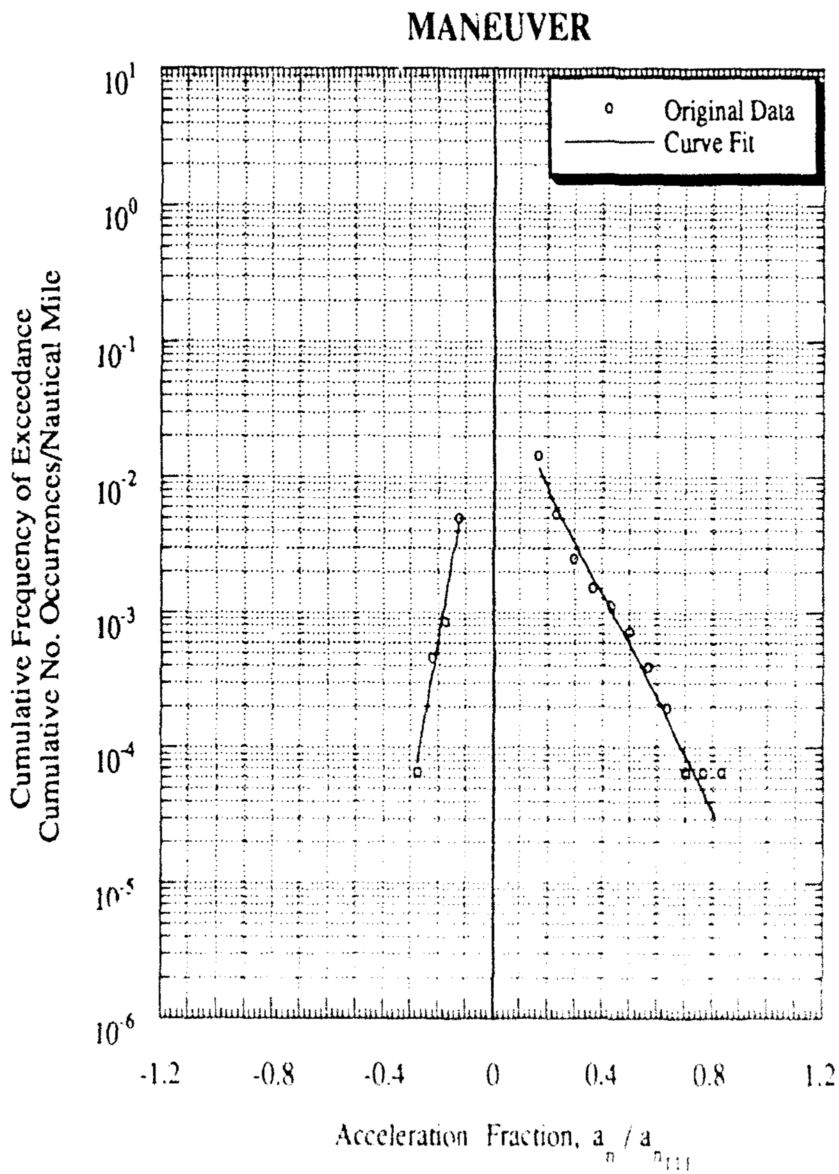


Table C-82 Tabulated Data for Airplane 2

Total Nautical Miles = 512980 Total Hours = 1389.3

GUST				MANEUVER			
negative		positive		negative		positive	
Acceleration Fraction	Cumulative Frequency of Exceedance	Acceleration Fraction	Cumulative Frequency of Exceedance	Acceleration Fraction	Cumulative Frequency of Exceedance	Acceleration Fraction	Cumulative Frequency of Exceedance
-0.150	0.0013584	0.150	0.0016967	-0.150	0.0006041	0.150	0.0007096
-0.200	0.0002400	0.200	0.0003166	-0.200	0.0001760	0.200	0.0003144
-0.250	0.5664E-04	0.250	0.7431E-04	-0.250	0.5904E-04	0.250	0.0001570
-0.300	0.1573E-04	0.300	0.1957E-04	-0.300	0.2104E-04	0.300	0.8340E-04
-0.350	0.4805E-05	0.350	0.5441E-05	-0.350	0.7638E-05	0.350	0.4574E-04
-0.400	0.1516E-05	0.400	0.1533E-05	-0.400	0.2772E-05	0.400	0.2544E-04
						0.450	0.1418E-04
						0.500	0.7860E-05

NOTE: for curve fits x = |x|

Curve fit for original data (-0.350 < x < -0.153)
$\log(y) = -7.166 - 4.830x^2 - 5.349\log(x)$
Curve fit for extrapolation (-0.458 < x < -0.350)
$\log(y) = -1.812 - 10.018x$

Curve fit for original data (0.153 < x < 0.350)
$\log(y) = -6.593 - 7.148x^2 - 4.835\log(x)$
Curve fit for extrapolation (0.350 < x < 0.424)
$\log(y) = -1.413 - 11.003x$

Curve fit for original data (-0.350 < x < -0.163)
$\log(y) = -5.837 - 6.622x^2 - 3.359\log(x)$
Curve fit for extrapolation (-0.417 < x < -0.350)
$\log(y) = -2.036 - 8.803x$

Curve fit for original data (0.132 < x < 0.500)
$\log(y) = -5.054 - 3.088x^2 - 2.397\log(x)$

Figure C-82 Load Spectra for Airplane 2, Twin-Engine, Executive Jet

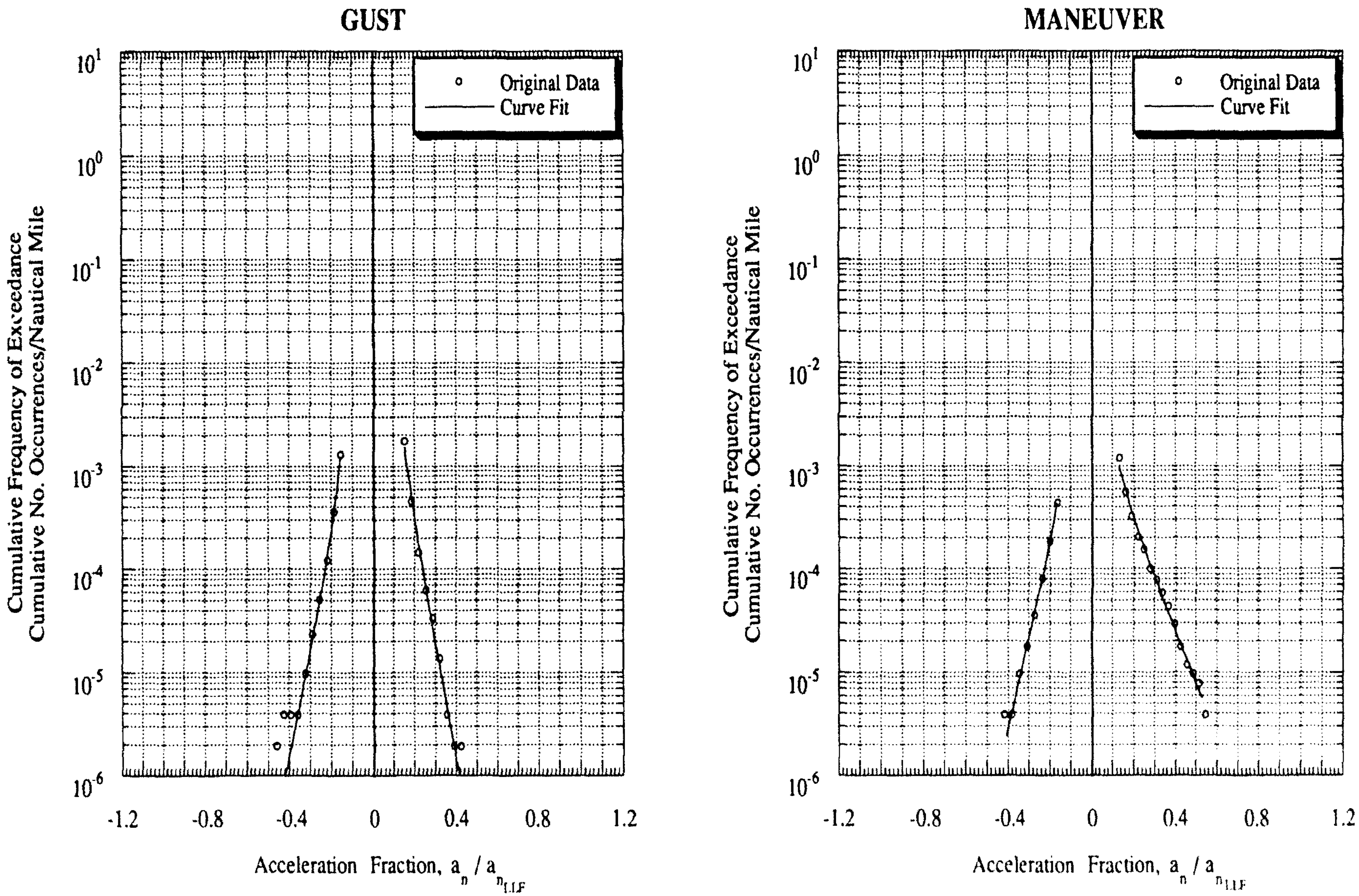


Table C-83 Tabulated Data for Airplane 2A

Total Nautical Miles = 216991 Total Hours = 597

GUST				MANEUVER			
negative		positive		negative		positive	
Acceleration Fraction	Cumulative Frequency of Exceedance	Acceleration Fraction	Cumulative Frequency of Exceedance	Acceleration Fraction	Cumulative Frequency of Exceedance	Acceleration Fraction	Cumulative Frequency of Exceedance
-0.200	0.0027116	0.200	0.0029091	-0.150	0.0036824	0.150	0.0029815
-0.250	0.0006249	0.250	0.0007907	-0.200	0.0006431	0.200	0.0007170
-0.300	0.0001611	0.300	0.0002349	-0.250	0.0001477	0.250	0.0002464
-0.350	0.4373E-04	0.350	0.7234E-04	-0.300	0.3937E-04	0.300	0.0001070
-0.400	0.1204E-04	0.400	0.2237E-04			0.350	0.5491E-04
		0.450	0.6810E-05			0.400	0.3205E-04
		0.500	0.2046E-05			0.450	0.2073E-04
						0.500	0.1403E-04
						0.550	0.9498E-05
						0.600	0.6428E-05
						0.650	0.4351E-05

NOTE: for curve fits $x = |x|$

Curve fit for original data $(-0.400 < x < -0.184)$
$\log(y) = -5.660 - 7.437x^2 - 4.851\log(x)$

Curve fit for original data $(0.184 < x < 0.450)$
$\log(y) = -5.177 - 7.119x^2 - 4.185\log(x)$
Curve fit for extrapolation $(0.450 < x < 0.676)$
$\log(y) = -0.466 - 10.446x$

Curve fit for original data $(-0.300 < x < -0.163)$
$\log(y) = -6.642 - 5.723x^2 - 5.264\log(x)$

Curve fit for original data $(0.132 < x < 0.450)$
$\log(y) = -6.858 + 1.818x^2 - 5.209\log(x)$
Curve fit for extrapolation $(0.450 < x < 0.662)$
$\log(y) = -3.158 - 3.390x$

Figure C-83 Load Spectra for Airplane 2A, Twin-Engine, Executive Jet

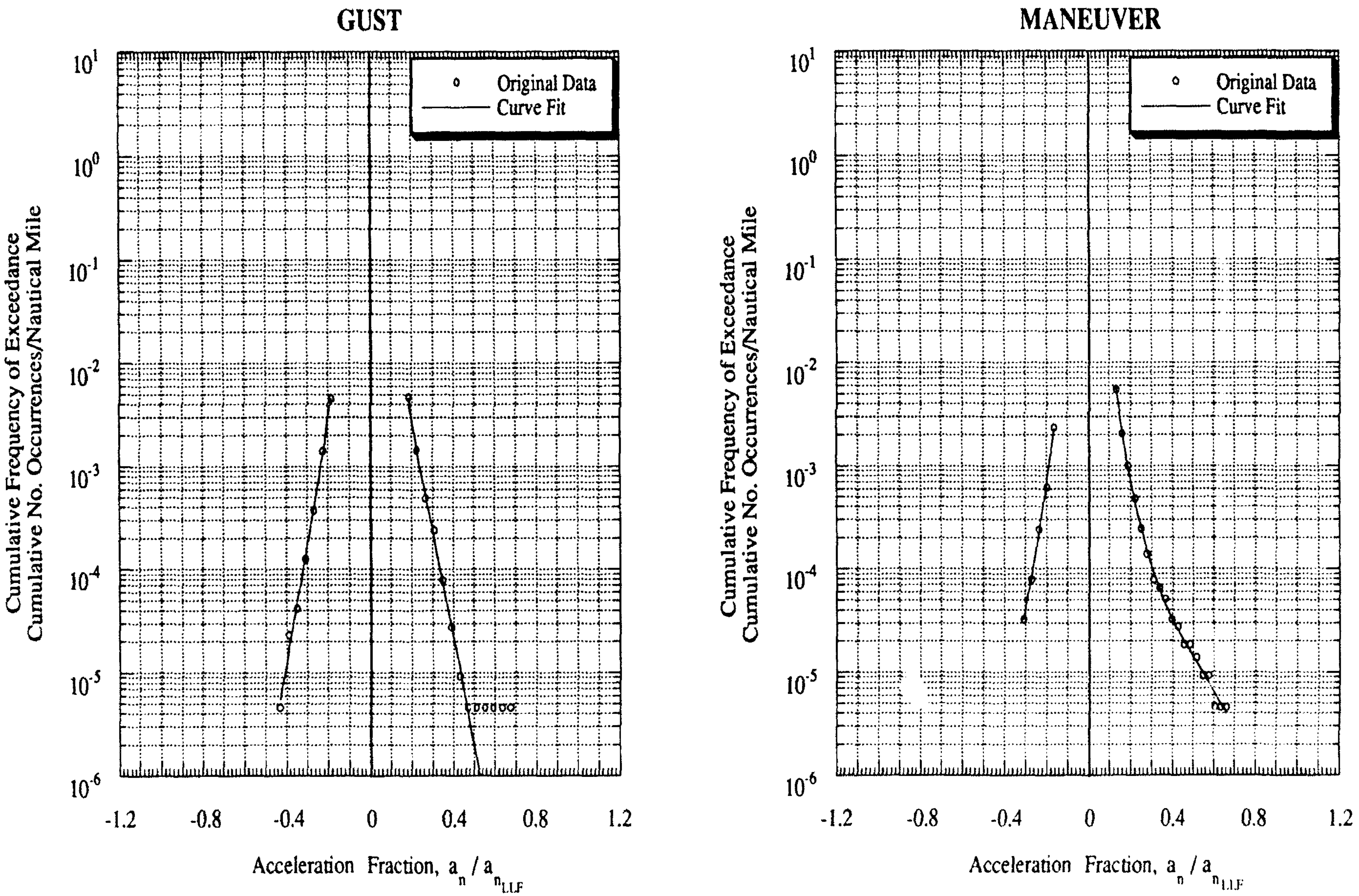


Table C-84 Tabulated Data for Airplane 19

Total Nautical Miles = 24743 Total Hours = 143

GUST				MANEUVER			
negative		positive		negative		positive	
Acceleration Fraction	Cumulative Frequency of Exceedance	Acceleration Fraction	Cumulative Frequency of Exceedance	Acceleration Fraction	Cumulative Frequency of Exceedance	Acceleration Fraction	Cumulative Frequency of Exceedance
-0.300	0.0044166	0.300	0.0071018	-0.200	0.0306278	0.250	0.1013071
-0.350	0.0025037	0.350	0.0040161	-0.250	0.0116142	0.300	0.0647826
-0.400	0.0014460	0.400	0.0023857	-0.300	0.0044494	0.350	0.0433880
-0.450	0.0008410	0.450	0.0014664	-0.350	0.0016685	0.400	0.0299607
-0.500	0.0004886	0.500	0.0009231	-0.400	0.0006010	0.450	0.0211157
-0.550	0.0002820	0.550	0.0005909	-0.450	0.0002055	0.500	0.0150842
-0.600	0.0001610	0.600	0.0003824	-0.500	0.6610E-04	0.550	0.0108683
-0.650	0.9066E-04	0.650	0.0002493	-0.550	0.2058E-04	0.600	0.0078694
-0.700	0.5065E-04	0.700	0.0001631	-0.600	0.6411E-05	0.650	0.0057103
-0.750	0.2829E-04	0.750	0.0001069			0.700	0.0041436
-0.800	0.1580E-04	0.800	0.6996E-04			0.750	0.0030017
-0.850	0.8829E-05	0.850	0.4570E-04			0.800	0.0021678
-0.900	0.4932E-05	0.900	0.2980E-04			0.850	0.0015590
						0.900	0.0011155
						0.950	0.0007934
						1.000	0.0005606
						1.050	0.0003933
						1.100	0.0002739
						1.150	0.0001892
						1.200	0.0001296
						1.250	0.8837E-04
						1.300	0.6026E-04
						1.350	0.4110E-04
						1.400	0.2803E-04

NOTE: for curve fits $x = |x|$

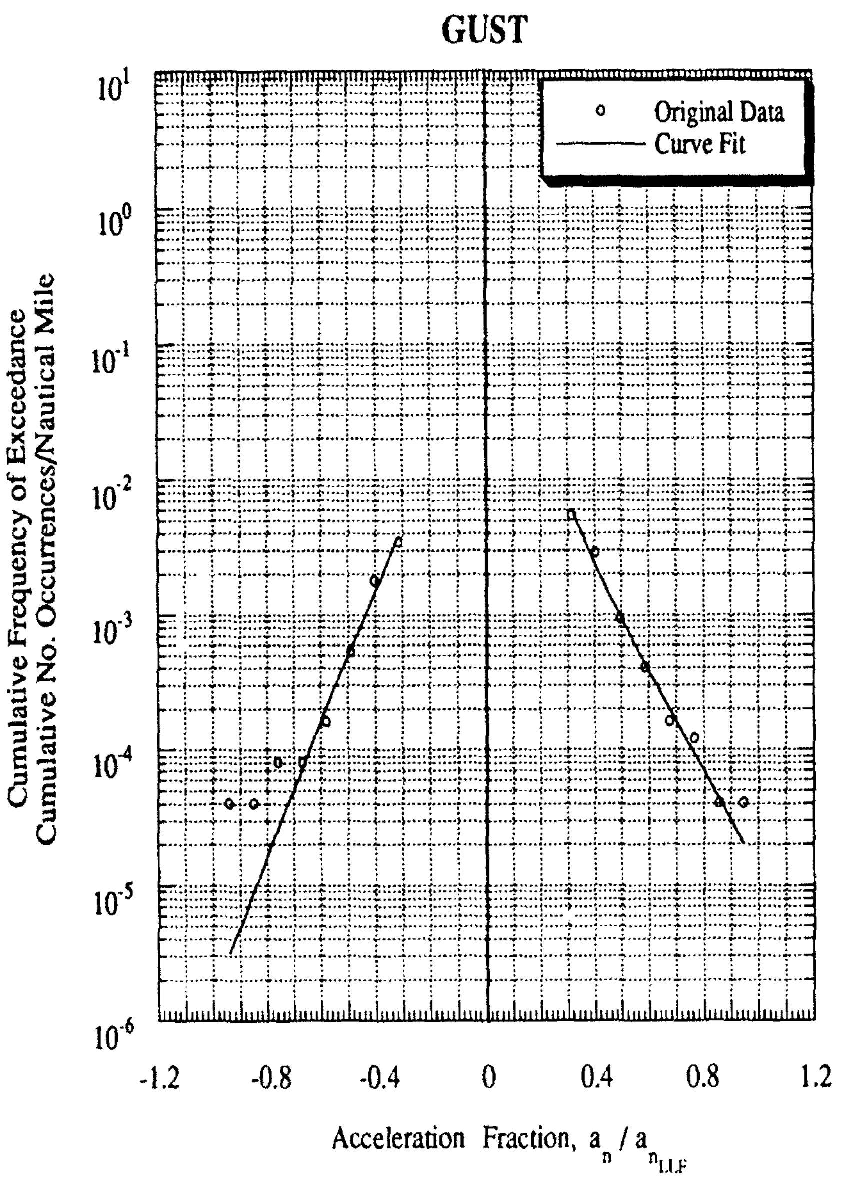
Curve fit for original data ($-0.650 < x < -0.313$)
$\log(y) = -3.365 - 2.662x^2 - 2.390\log(x)$
Curve fit for extrapolation ($-0.938 < x < -0.650$)
$\log(y) = -0.755 - 5.058x$

Curve fit for original data ($0.315 < x < 0.850$)
$\log(y) = -3.650 - 1.257x^2 - 3.088\log(x)$
Curve fit for extrapolation ($0.850 < x < 0.946$)
$\log(y) = -1.183 - 3.714x$

Curve fit for original data ($-0.500 < x < -0.175$)
$\log(y) = -2.940 - 7.964x^2 - 2.496\log(x)$
Curve fit for extrapolation ($-0.625 < x < -0.500$)
$\log(y) = 0.887 - 10.133x$

Curve fit for original data ($0.233 < x < 1.200$)
$\log(y) = -2.180 - 1.072x^2 - 2.080\log(x)$
Curve fit for extrapolation ($1.200 < x < 1.433$)
$\log(y) = 0.102 - 3.324x$

Figure C-84 Load Spectra for Airplane 19, Large Airplanes, Special Usage



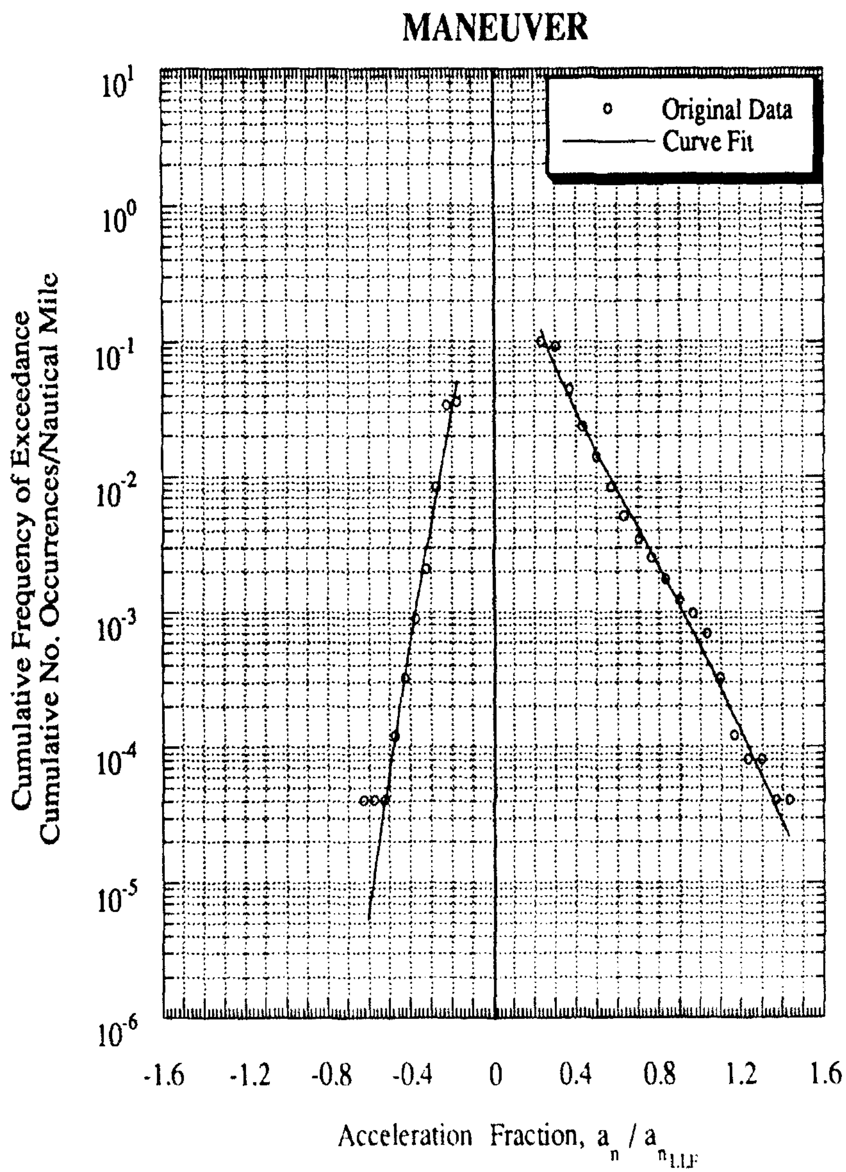


Table C-85 Tabulated Data for Airplane 19[1]

Total Nautical Miles = 4245

Total Hours = 24

GUST				MANEUVER			
negative		positive		negative		positive	
Acceleration Fraction	Cumulative Frequency of Exceedance	Acceleration Fraction	Cumulative Frequency of Exceedance	Acceleration Fraction	Cumulative Frequency of Exceedance	Acceleration Fraction	Cumulative Frequency of Exceedance
-0.300	0.0010427	0.300	0.0057435	-0.200	0.0022346	0.250	0.0515632
-0.350	0.0007064	0.350	0.0035293	-0.250	0.0008992	0.300	0.0330597
-0.400	0.0004785	0.400	0.0020122			0.350	0.0204980
		0.450	0.0010644			0.400	0.0122193
						0.450	0.0069770
						0.500	0.0038060
						0.550	0.0019799
						0.600	0.0009809
						0.650	0.0004623

NOTE: for curve fits x = |x|

Curve fit for original data ($-0.400 < x < -0.313$)
$\log(y) = -1.967 - 3.383x$

Curve fit for original data ($0.315 < x < 0.450$)
$\log(y) = -1.655 - 6.507x^2$

Curve fit for original data ($-0.250 < x < -0.175$)
$\log(y) = -1.948 - 17.572x^2$

Curve fit for original data ($0.233 < x < 0.700$)
$\log(y) = -1.452 - 4.798x^2 - 0.772\log(x)$

Figure C-85 Load Spectra for Airplane 19[1], Large Airplanes, Special Usage

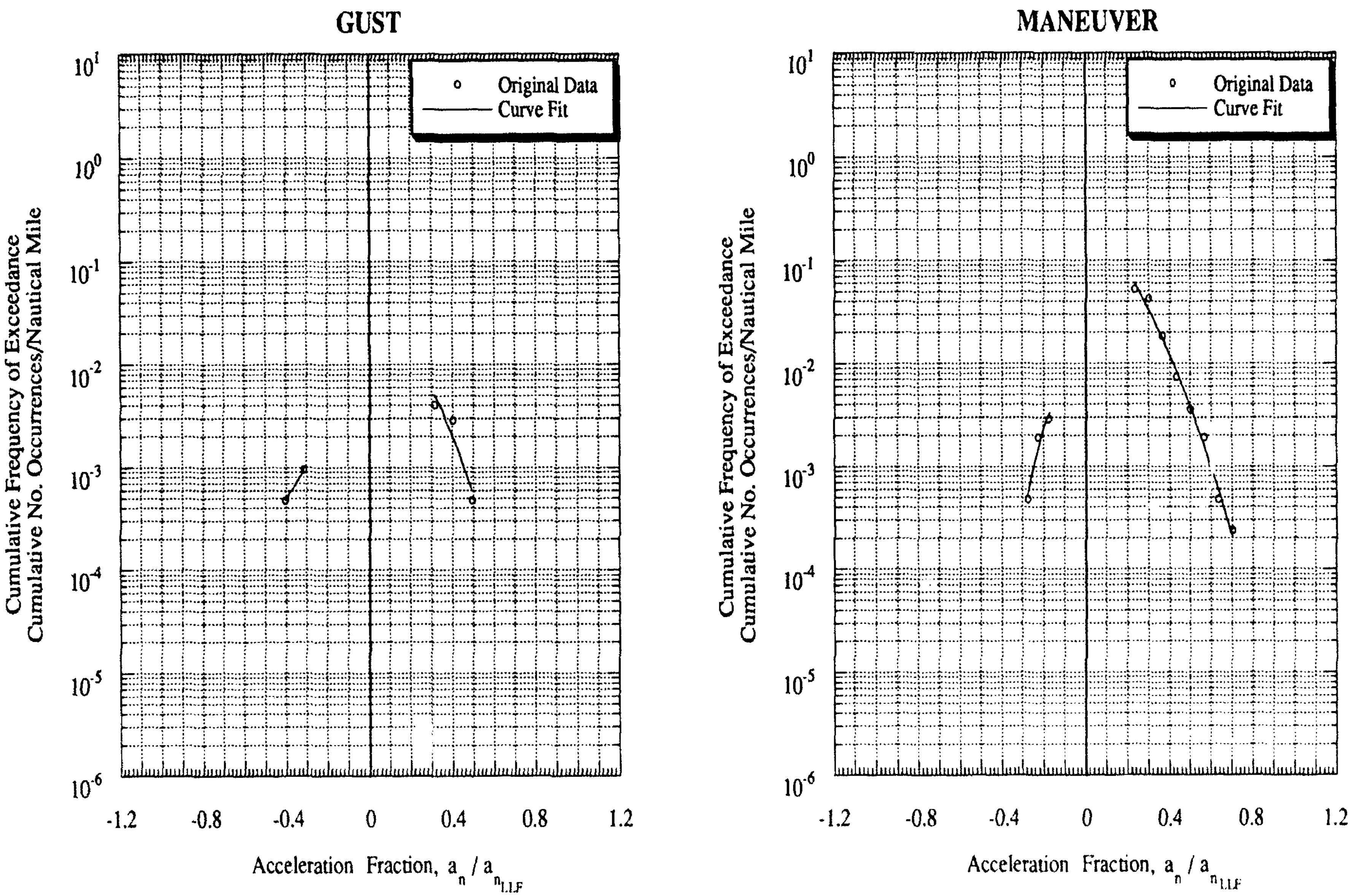


Table C-86 Tabulated Data for Airplane 20

Total Nautical Miles = 50316 Total Hours = 285

GUST				MANEUVER			
negative		positive		negative		positive	
Acceleration Fraction	Cumulative Frequency of Exceedance	Acceleration Fraction	Cumulative Frequency of Exceedance	Acceleration Fraction	Cumulative Frequency of Exceedance	Acceleration Fraction	Cumulative Frequency of Exceedance
-0.200	0.0221640	0.200	0.0358179	-0.200	0.0130974	0.250	0.0611892
-0.250	0.0080142	0.250	0.0127518	-0.250	0.0062428	0.300	0.0419829
-0.300	0.0032765	0.300	0.0052100	-0.300	0.0028250	0.350	0.0301885
-0.350	0.0014425	0.350	0.0023206	-0.350	0.0011946	0.400	0.0224289
-0.400	0.0006642	0.400	0.0010927	-0.400	0.0004677	0.450	0.0170606
-0.450	0.0003139	0.450	0.0005333	-0.450	0.0001685	0.500	0.0132033
-0.500	0.0001503	0.500	0.0002662	-0.500	0.5562E-04	0.550	0.0103497
-0.550	0.7229E-04	0.550	0.0001346	-0.550	0.1756E-04	0.600	0.0081904
-0.600	0.3467E-04	0.600	0.6828E-04	-0.600	0.5542E-05	0.650	0.0065272
		0.650	0.3465E-04	-0.650	0.1749E-05	0.700	0.0052281
						0.750	0.0042023
						0.800	0.0033855
						0.850	0.0027309
						0.900	0.0022037
						0.950	0.0017778
						1.000	0.0014330
						1.050	0.0011534
						1.100	0.0009267
						1.150	0.0007428
						1.200	0.0005940
						1.250	0.0004736
						1.300	0.0003765
						1.350	0.0002982
						1.400	0.0002354
						1.450	0.0001852
						1.500	0.0001451
						1.550	0.0001132
						1.600	0.8798E-04
						1.650	0.6808E-04
						1.700	0.5245E-04
						1.750	0.4032E-04
						1.800	0.3099E-04
						1.850	0.2383E-04
						1.900	0.1832E-04
						1.950	0.1408E-04

NOTE: for curve fits x = |x|

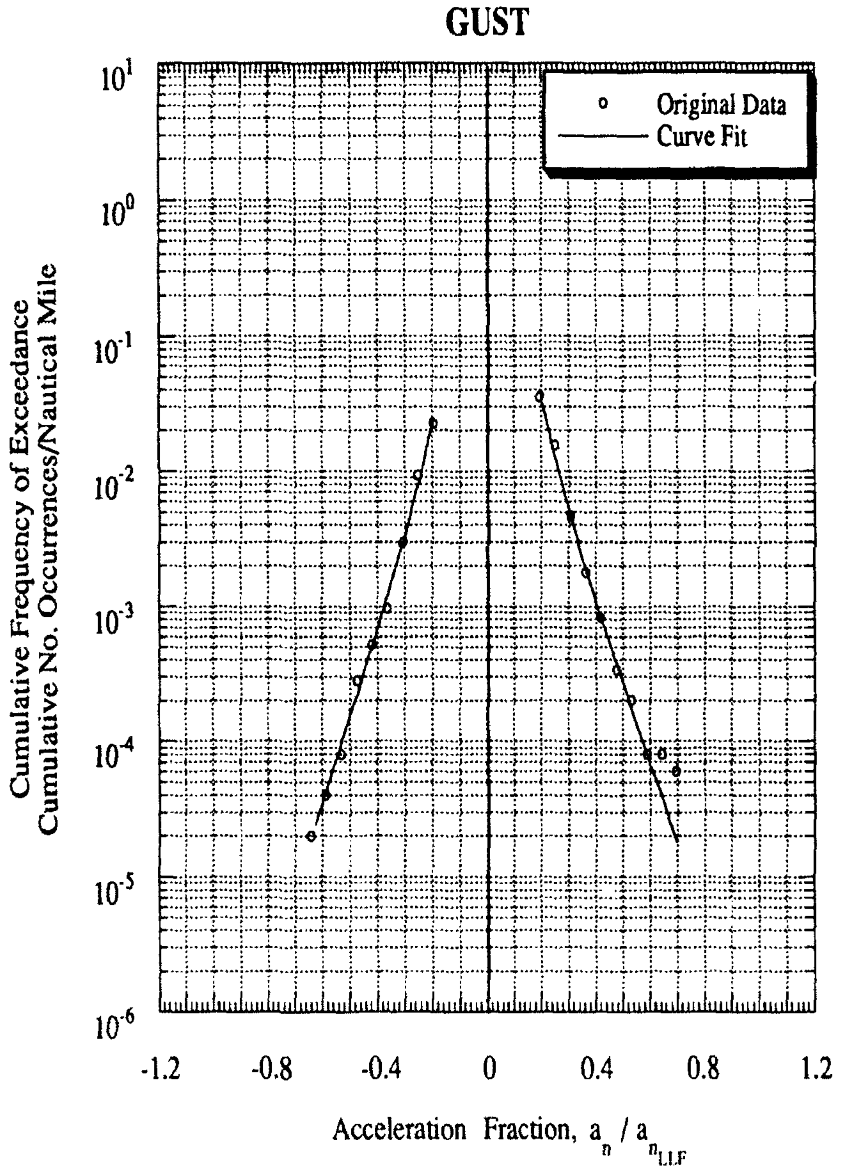
Curve fit for original data ($-0.600 < x < -0.196$)
$\log(y) = -4.231 - 3.014x^2 - 3.859\log(x)$

Curve fit for original data ($0.196 < x < 0.550$)
$\log(y) = -4.187 - 2.441x^2 - 4.062\log(x)$
Curve fit for extrapolation ($0.550 < x < 0.698$)
$\log(y) = -0.630 - 5.892x$

Curve fit for original data ($-0.500 < x < -0.175$)
$\log(y) = -2.397 - 8.933x^2 - 1.247\log(x)$
Curve fit for extrapolation ($-0.925 < x < -0.500$)
$\log(y) = 0.753 - 10.016x$

Curve fit for original data ($0.233 < x < 1.700$)
$\log(y) = -2.313 - 0.531x^2 - 1.882\log(x)$
Curve fit for extrapolation ($1.700 < x < 1.967$)
$\log(y) = -0.396 - 2.285x$

Figure C-86 Load Spectra for Airplane 20, Large Airplanes, Special Usage



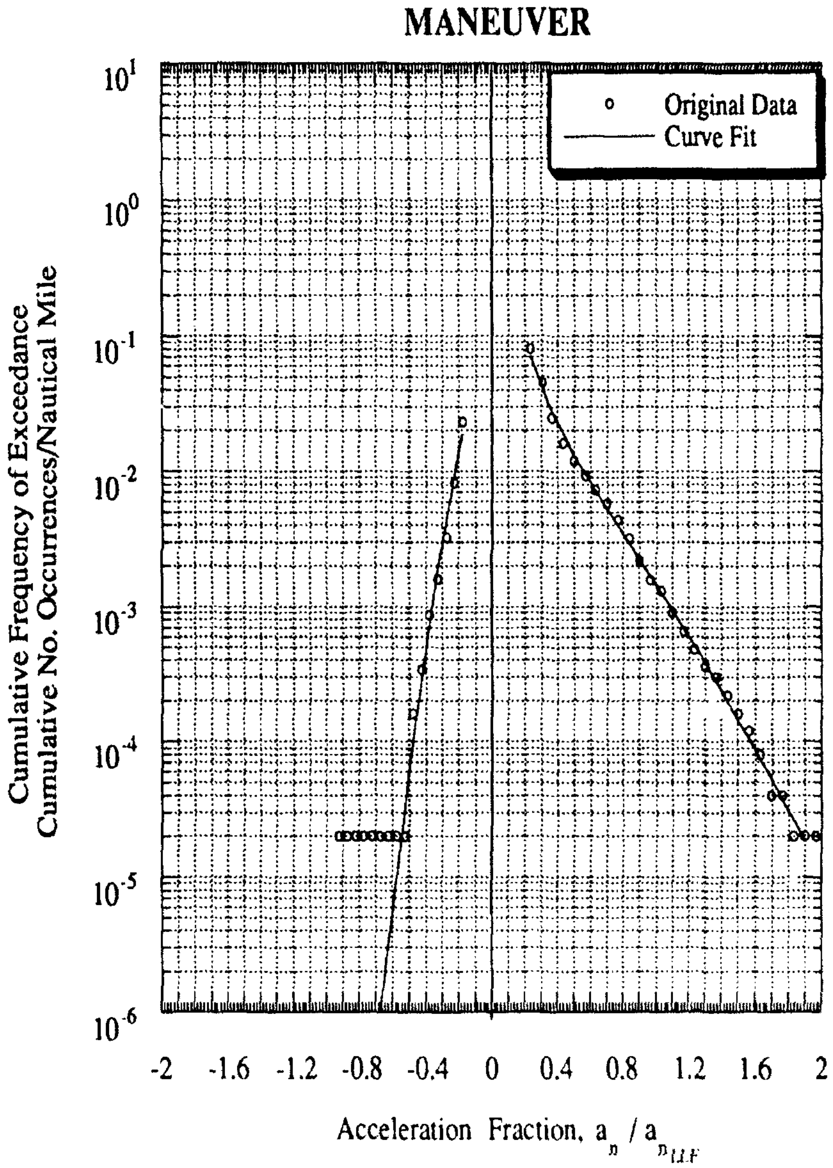


Table C-87 Tabulated Data for Airplane 20[1]

Total Nautical Miles = 58213 Total Hours = 328

GUST negative: Acceleration Fraction	Cumulative Frequency of Exceedance	GUST positive: Acceleration Fraction	Cumulative Frequency of Exceedance	MANEUVER negative: Acceleration Fraction	Cumulative Frequency of Exceedance	MANEUVER positive: Acceleration Fraction	Cumulative Frequency of Exceedance
-0.200	0.1421249	0.200	0.0187393	-0.200	0.0153189	0.250	0.0469567
-0.250	0.0934276	0.250	0.0081427	-0.250	0.0060050	0.300	0.0373272
-0.300	0.0487735	0.300	0.0034981	-0.300	0.0026391	0.350	0.0301065
-0.350	0.0206128	0.350	0.0014500	-0.350	0.0012430	0.400	0.0244677
-0.400	0.0071337	0.400	0.0005716	-0.400	0.0006108	0.450	0.0199472
-0.450	0.0020367	0.450	0.0002123	-0.450	0.0003077	0.500	0.0162632
-0.500	0.0004821			-0.500	0.0001570	0.550	0.0132317
-0.550	0.9497E-04			-0.550	0.8052E-04	0.600	0.0107254
				-0.600	0.4122E-04	0.650	0.0086512
				-0.650	0.2096E-04	0.700	0.0069372
				-0.700	0.1062E-04	0.750	0.0055260
				-0.750	0.5375E-05	0.800	0.0043702
						0.850	0.0034295
						0.900	0.0026695
						0.950	0.0020603
						1.000	0.0015763
						1.050	0.0011951
						1.100	0.0008978
						1.150	0.0006681
						1.200	0.0004925
						1.250	0.0003595
						1.300	0.0002598
						1.350	0.0001859
						1.400	0.0001317
						1.450	0.9238E-04
						1.500	0.6413E-04
						1.550	0.4406E-04
						1.600	0.2996E-04
						1.650	0.2026E-04
						1.700	0.1371E-04

NOTE: for curve fits x = |x|

Curve fit for original data (-0.550 < x < -0.196)
$\log(y) = 0.799 - 14.636x^2 + 1.518\log(x)$

Curve fit for original data (0.196 < x < 0.450)
$\log(y) = -2.759 - 7.807x^2 - 1.923\log(x)$

Curve fit for original data (-0.650 < x < -0.175)
$\log(y) = -4.199 - 2.714x^2 - 3.567\log(x)$
Curve fit for extrapolation (-0.775 < x < -0.650)
$\log(y) = -0.836 - 5.911x$

Curve fit for original data (0.233 < x < 1.600)
$\log(y) = -1.819 - 0.983x^2 - 0.917\log(x)$
Curve fit for extrapolation (1.600 < x < 1.700)
$\log(y) = 0.909 - 3.395x$

Figure C-87 Load Spectra for Airplane 20[1], Large Airplanes, Special Usage

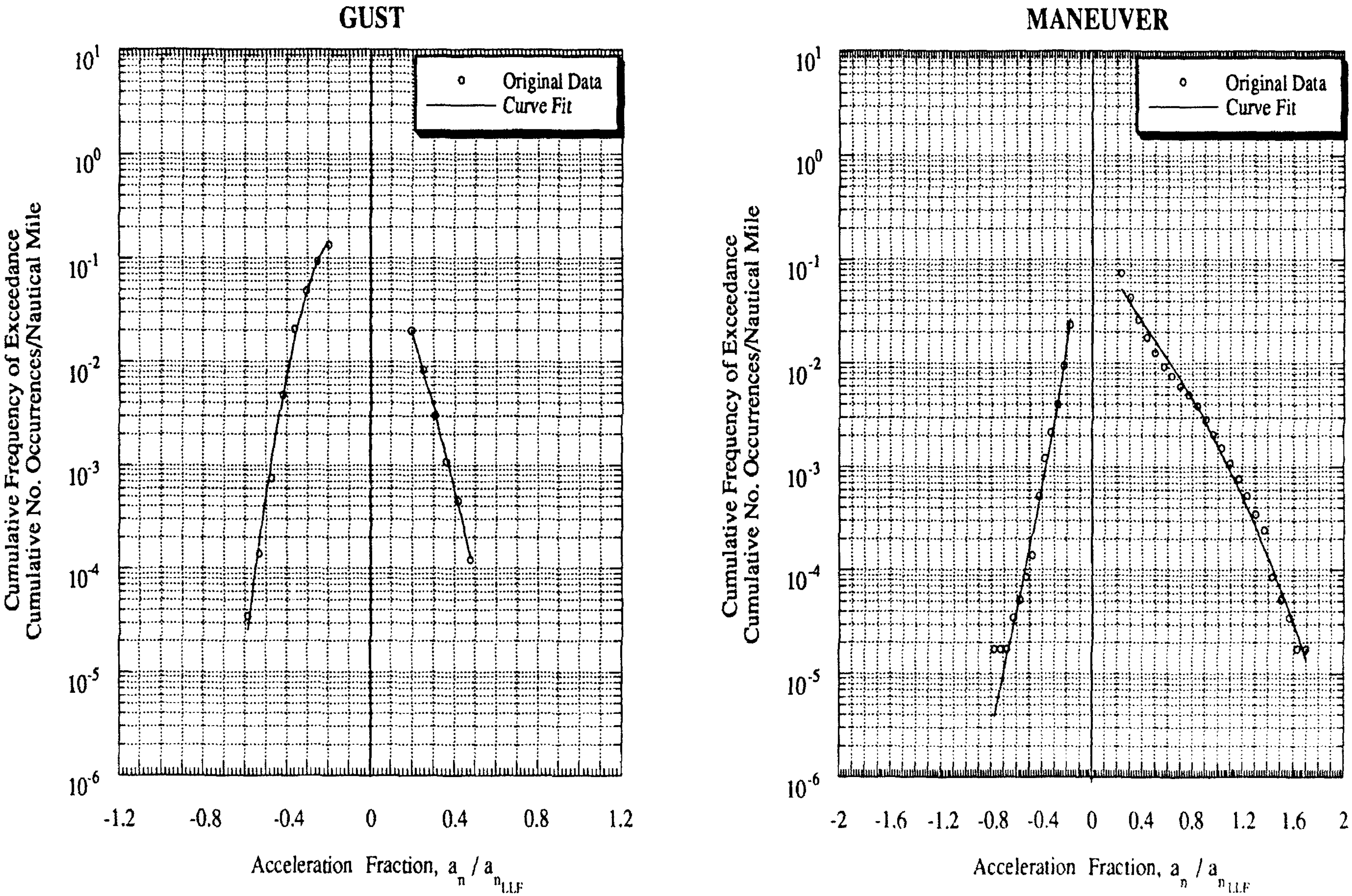


Table C-88 Tabulated Data for Airplane 21

Total Nautical Miles = 53440 Total Hours = 305

GUST				MANEUVER			
negative		positive		negative		positive	
Acceleration Fraction	Cumulative Frequency of Exceedance	Acceleration Fraction	Cumulative Frequency of Exceedance	Acceleration Fraction	Cumulative Frequency of Exceedance	Acceleration Fraction	Cumulative Frequency of Exceedance
-0.200	0.0097404	0.200	0.0115621	-0.150	0.0299710	0.150	0.0591934
-0.250	0.0051328	0.250	0.0064551	-0.200	0.0139142	0.200	0.0369642
-0.300	0.0028259	0.300	0.0038892	-0.250	0.0071494	0.250	0.0251612
-0.350	0.0015838	0.350	0.0024570	-0.300	0.0038604	0.300	0.0180148
-0.400	0.0008896	0.400	0.0015999	-0.350	0.0021308	0.350	0.0133109
-0.450	0.0004958	0.450	0.0010619	-0.400	0.0011825	0.400	0.0100354
-0.500	0.0002723	0.500	0.0007130	-0.450	0.0006529	0.450	0.0076635
-0.550	0.0001466	0.550	0.0004817	-0.500	0.0003560	0.500	0.0058981
-0.600	0.7717E-04	0.600	0.0003261	-0.550	0.0001907	0.550	0.0045587
-0.650	0.4011E-04	0.650	0.0002206	-0.600	0.0001000	0.600	0.0035291
-0.700	0.2084E-04	0.700	0.0001488			0.650	0.0027310
-0.750	0.1083E-04	0.750	0.9984E-04			0.700	0.0021093
-0.800	0.5629E-05	0.800	0.6655E-04			0.750	0.0016239
-0.850	0.2925E-05	0.850	0.4420E-04			0.800	0.0012450
-0.900	0.1520E-05	0.900	0.2935E-04			0.850	0.0009498
		0.950	0.1949E-04			0.900	0.0007204
		1.000	0.1295E-04			0.950	0.0005431
		1.050	0.8597E-05			1.000	0.0004067
		1.100	0.5709E-05			1.050	0.0003024
		1.150	0.3792E-05			1.100	0.0002231
		1.200	0.2518E-05			1.150	0.0001634
		1.250	0.1672E-05			1.200	0.0001192
		1.300	0.1111E-05			1.250	0.8692E-04
						1.300	0.6340E-04
						1.350	0.4624E-04
						1.400	0.3373E-04
						1.450	0.2460E-04

NOTE: *for curve fits* $x = |x|$

Curve fit for original data ($-0.600 < x < -0.191$)
$\log(y) = -3.311 - 3.495x^2 - 2.059\log(x)$
Curve fit for extrapolation ($-0.954 < x < -0.600$)
$\log(y) = -0.701 - 5.685x$

Curve fit for original data ($0.191 < x < 0.800$)
$\log(y) = -3.469 - 1.450x^2 - 2.275\log(x)$
Curve fit for extrapolation ($0.800 < x < 1.794$)
$\log(y) = -1.333 - 3.555x$

Curve fit for original data ($-0.600 < x < -0.125$)
$\log(y) = -3.247 - 3.440x^2 - 2.185\log(x)$

Curve fit for original data ($0.125 < x < 1.150$)
$\log(y) = -2.446 - 0.945x^2 - 1.504\log(x)$
Curve fit for extrapolation ($1.150 < x < 1.475$)
$\log(y) = -0.634 - 2.741x$

Figure C-88 Load Spectra for Airplane 21, Large Airplanes, Special Usage

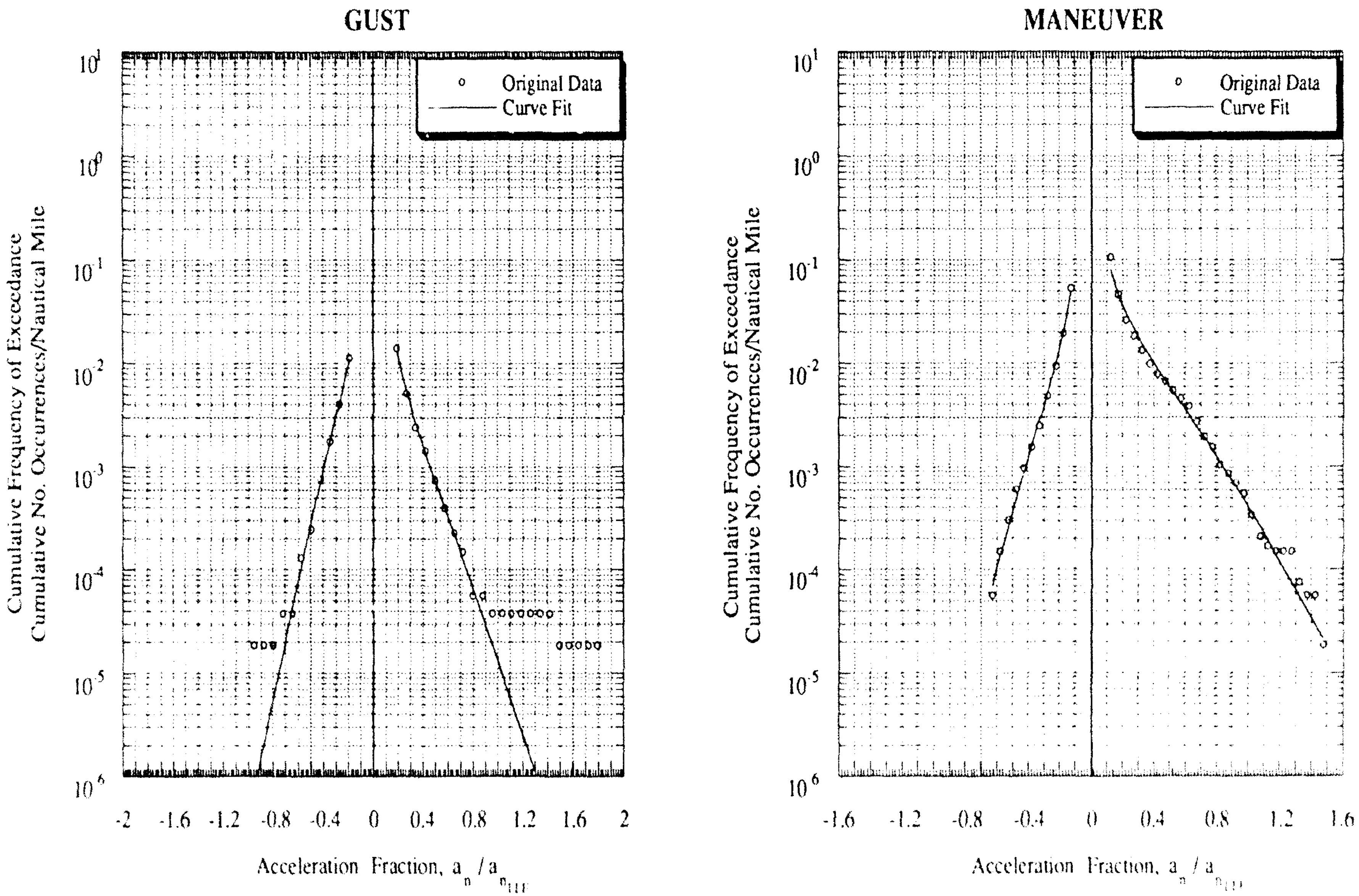


Table C-89 Tabulated Data for Airplane 22

Total Nautical Miles = 4052 Total Hours = 29

GUST				MANEUVER			
negative		positive		negative		positive	
Acceleration Fraction	Cumulative Frequency of Exceedance	Acceleration Fraction	Cumulative Frequency of Exceedance	Acceleration Fraction	Cumulative Frequency of Exceedance	Acceleration Fraction	Cumulative Frequency of Exceedance
-0.200	0.0103500	0.200	0.0114873	-0.200	0.0427235	0.200	0.0684868
-0.250	0.0048669	0.250	0.0051926	-0.250	0.0170387	0.250	0.0511572
-0.300	0.0018689	0.300	0.0025082	-0.300	0.0077098	0.300	0.0396066
-0.350	0.0005890	0.350	0.0012514	-0.350	0.0037792	0.350	0.0313381
		0.400	0.0006319	-0.400	0.0019522	0.400	0.0251288
		0.450	0.0003188	-0.450	0.0010439	0.450	0.0203099
				-0.500	0.0005709	0.500	0.0164844
				-0.550	0.0003165	0.550	0.0134005
						0.600	0.0108894
						0.650	0.0088324
						0.700	0.0071424
						0.750	0.0057532
						0.800	0.0046126
						0.850	0.0036788
						0.900	0.0029171
						0.950	0.0022989
						1.000	0.0017999
						1.050	0.0013997
						1.100	0.0010846
						1.150	0.0008404
						1.200	0.0006513
						1.250	0.0005047
						1.300	0.0003911
						1.350	0.0003030
						1.400	0.0002348

NOTE: for curve fits $x = |x|$

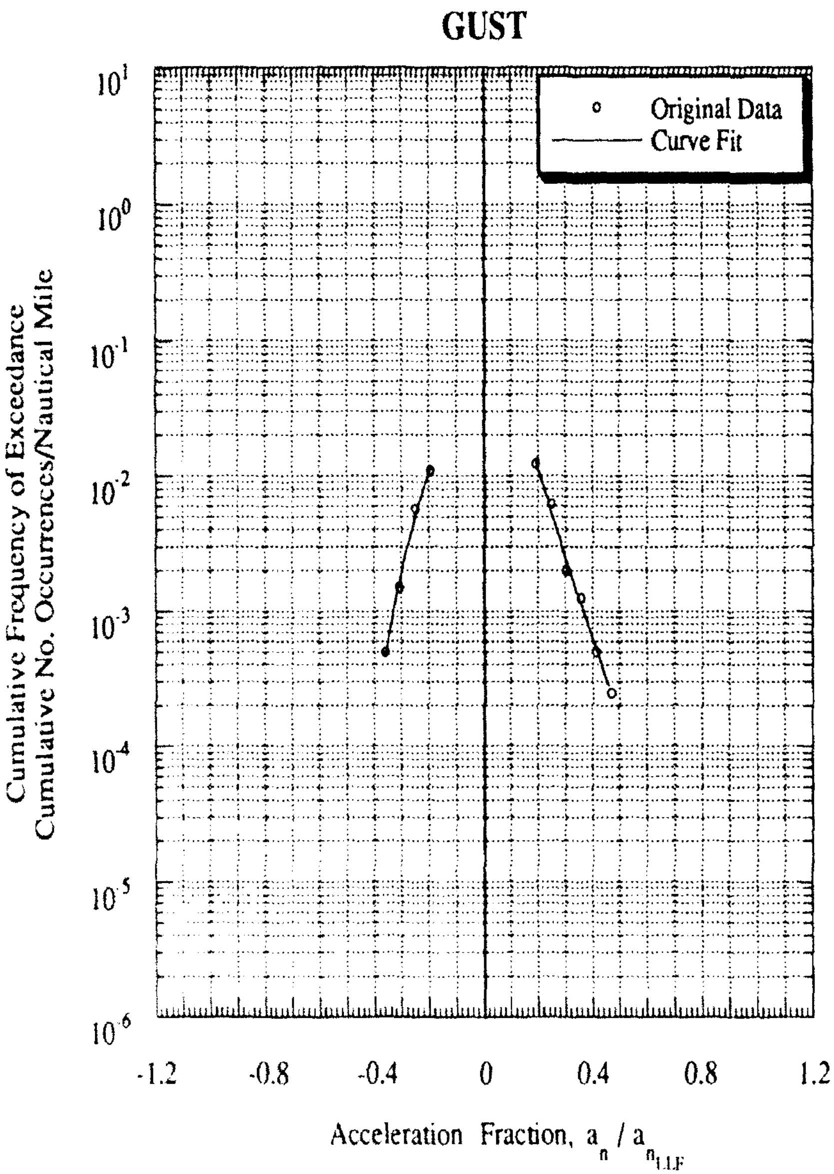
Curve fit for original data $(-0.350 < x < -0.193)$
$\log(y) = -1.067 - 16.225x^2 + 0.386\log(x)$

Curve fit for original data $(0.193 < x < 0.450)$
$\log(y) = -3.666 - 3.760x^2 - 2.685\log(x)$

Curve fit for original data $(-0.550 < x < -0.175)$
$\log(y) = -3.845 - 1.996x^2 - 3.656\log(x)$

Curve fit for original data $(0.175 < x < 1.050)$
$\log(y) = -1.909 - 0.836x^2 - 1.113\log(x)$
Curve fit for extrapolation $(1.050 < x < 1.425)$
$\log(y) = -0.528 - 2.215x$

Figure C-89 Load Spectra for Airplane 22, Large Airplanes, Special Usage



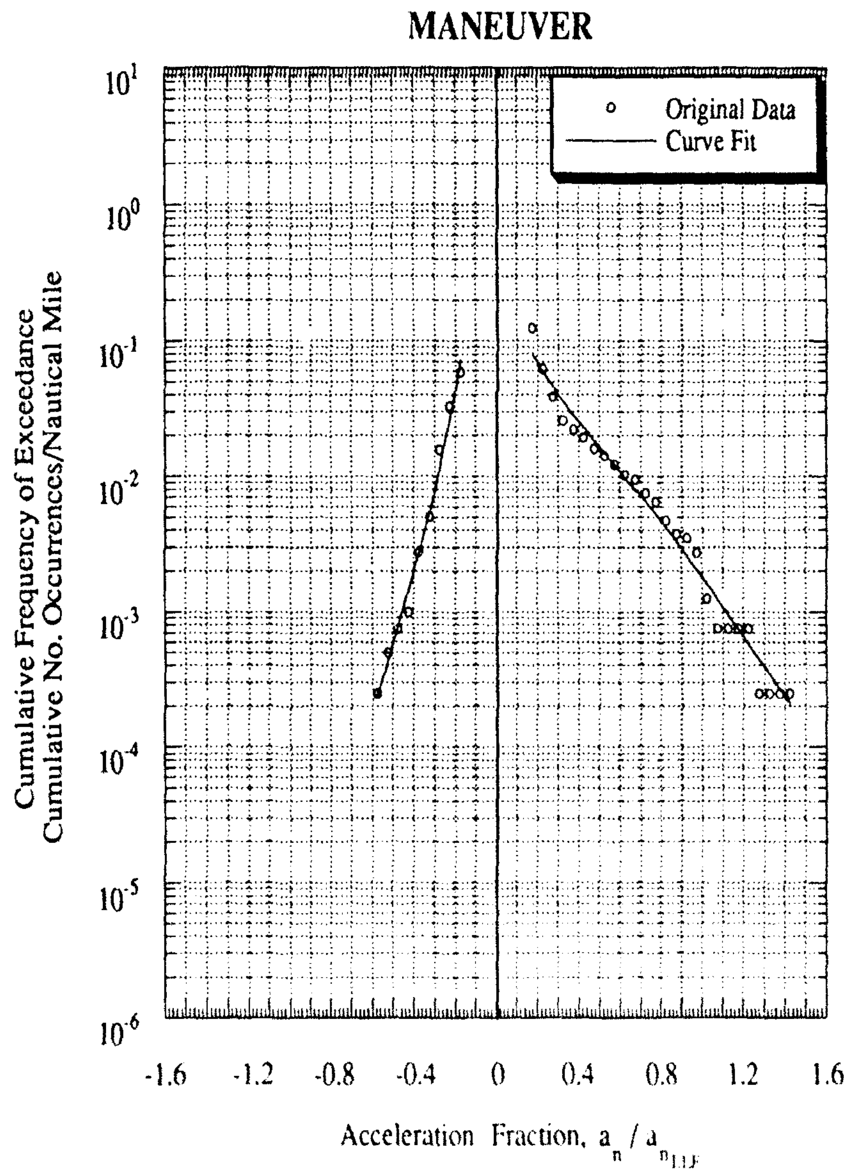


Table C-90 Tabulated Data for Airplane 23

Total Nautical Miles = 31242 Total Hours = 222

GUST				MANEUVER			
negative		positive		negative		positive	
Acceleration Fraction	Cumulative Frequency of Exceedance	Acceleration Fraction	Cumulative Frequency of Exceedance	Acceleration Fraction	Cumulative Frequency of Exceedance	Acceleration Fraction	Cumulative Frequency of Exceedance
-0.150	0.0229210	0.150	0.0375362	-0.200	0.0067751	0.250	0.0373917
-0.200	0.0046135	0.200	0.0087594	-0.250	0.0013943	0.300	0.0169644
-0.250	0.0013125	0.250	0.0020409	-0.300	0.0001363	0.350	0.0079785
-0.300	0.0004634	0.300	0.0004441			0.400	0.0038046
-0.350	0.0001895	0.350	0.8705E-04			0.450	0.0018135
-0.400	0.8610E-04					0.500	0.0008556
-0.450	0.4232E-04					0.550	0.0003969
						0.600	0.0001800
						0.650	0.7955E-04
						0.700	0.3466E-04
						0.750	0.1510E-04

NOTE: for curve fits $x = |x|$

Curve fit for original data ($-0.450 < x < -0.128$)
$\log(y) = -6.139 - 0.663x^2 - 5.480\log(x)$

Curve fit for original data ($0.128 < x < 0.350$)
$\log(y) = -3.392 - 15.959x^2 - 2.823\log(x)$

Curve fit for original data ($-0.300 < x < -0.175$)
$\log(y) = 2.840 - 49.241x^2 + 4.348\log(x)$

Curve fit for original data ($0.233 < x < 0.650$)
$\log(y) = -2.938 - 4.045x^2 - 2.930\log(x)$
Curve fit for extrapolation ($0.650 < x < 0.767$)
$\log(y) = 0.591 - 7.217x$

Figure C-90 Load Spectra for Airplane 23, Large Airplanes, Special Usage

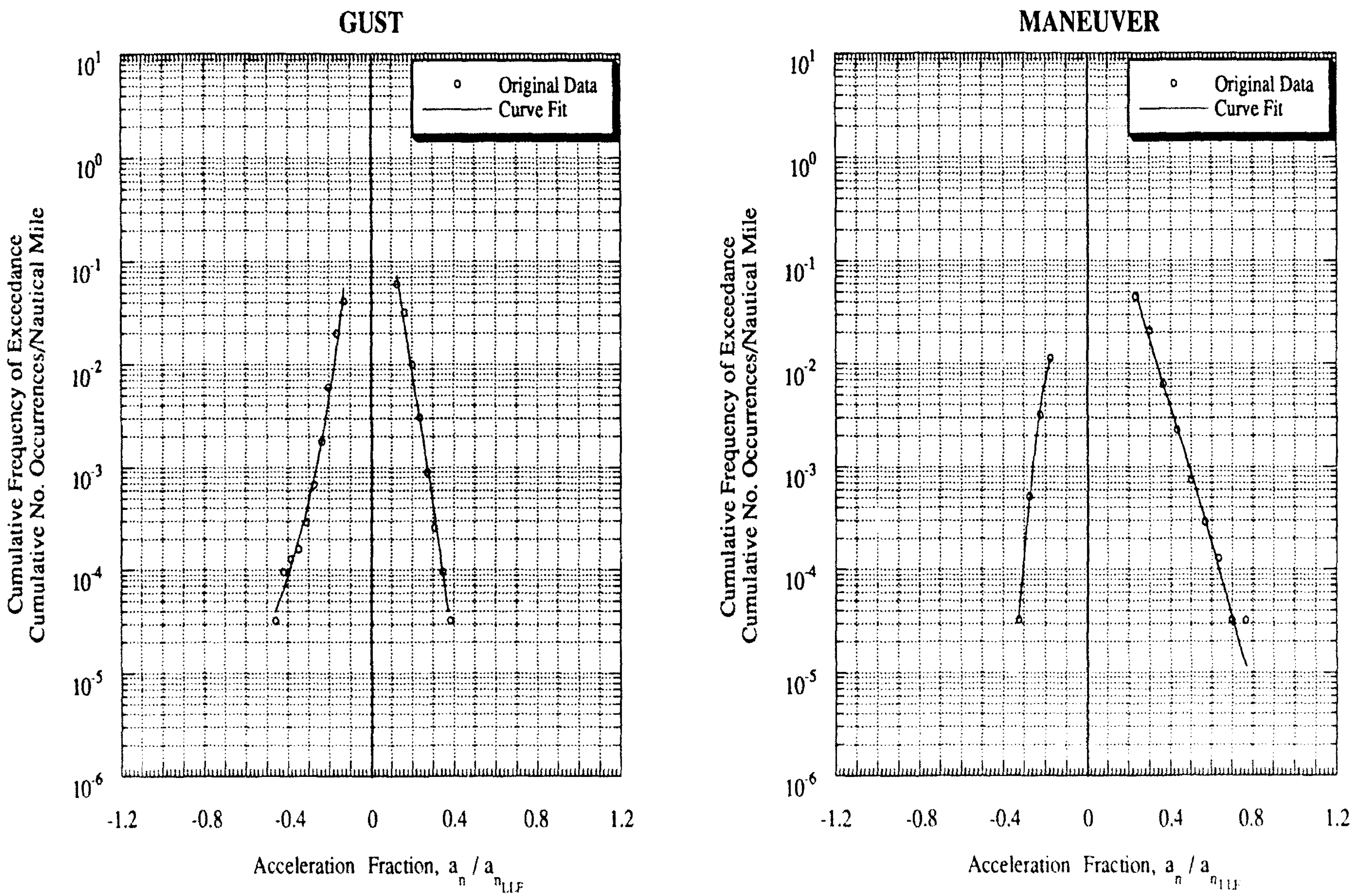


Table C-91 Tabulated Data for Airplane 24

Total Nautical Miles = 11969 Total Hours = 78

GUST negative Acceleration Fraction	GUST negative Cumulative Frequency of Exceedance	GUST positive Acceleration Fraction	GUST positive Cumulative Frequency of Exceedance	MANEUVER negative Acceleration Fraction	MANEUVER negative Cumulative Frequency of Exceedance	MANEUVER positive Acceleration Fraction	MANEUVER positive Cumulative Frequency of Exceedance
-0.150	0.0569868	0.150	0.0858353	-0.200	0.0167215	0.200	0.0903954
-0.200	0.0101153	0.200	0.0129773	-0.250	0.0072282	0.250	0.0716807
-0.250	0.0024150	0.250	0.0027712	-0.300	0.0034944	0.300	0.0586174
-0.300	0.0006825	0.300	0.0007244	-0.350	0.0018121	0.350	0.0488671
-0.350	0.0002133	0.350	0.0002148	-0.400	0.0009831	0.400	0.0412463
				-0.450	0.0005492	0.450	0.0350918
				-0.500	0.0003124	0.500	0.0300029
				-0.550	0.0001796	0.550	0.0257229
						0.600	0.0220792
						0.650	0.0189507
						0.700	0.0162495
						0.750	0.0139091
						0.800	0.0118781
						0.850	0.0101150
						0.900	0.0085857
						0.950	0.0072617
						1.000	0.0061181
						1.050	0.0051335
						1.100	0.0042887
						1.150	0.0035669
						1.200	0.0029527
						1.250	0.0024325
						1.300	0.0019941
						1.350	0.0016265
						1.400	0.0013199
						1.450	0.0010655
						1.500	0.0008555
						1.550	0.0006833
						1.600	0.0005442
						1.650	0.0004335

NOTE: *for curve fits* $x = |x|$

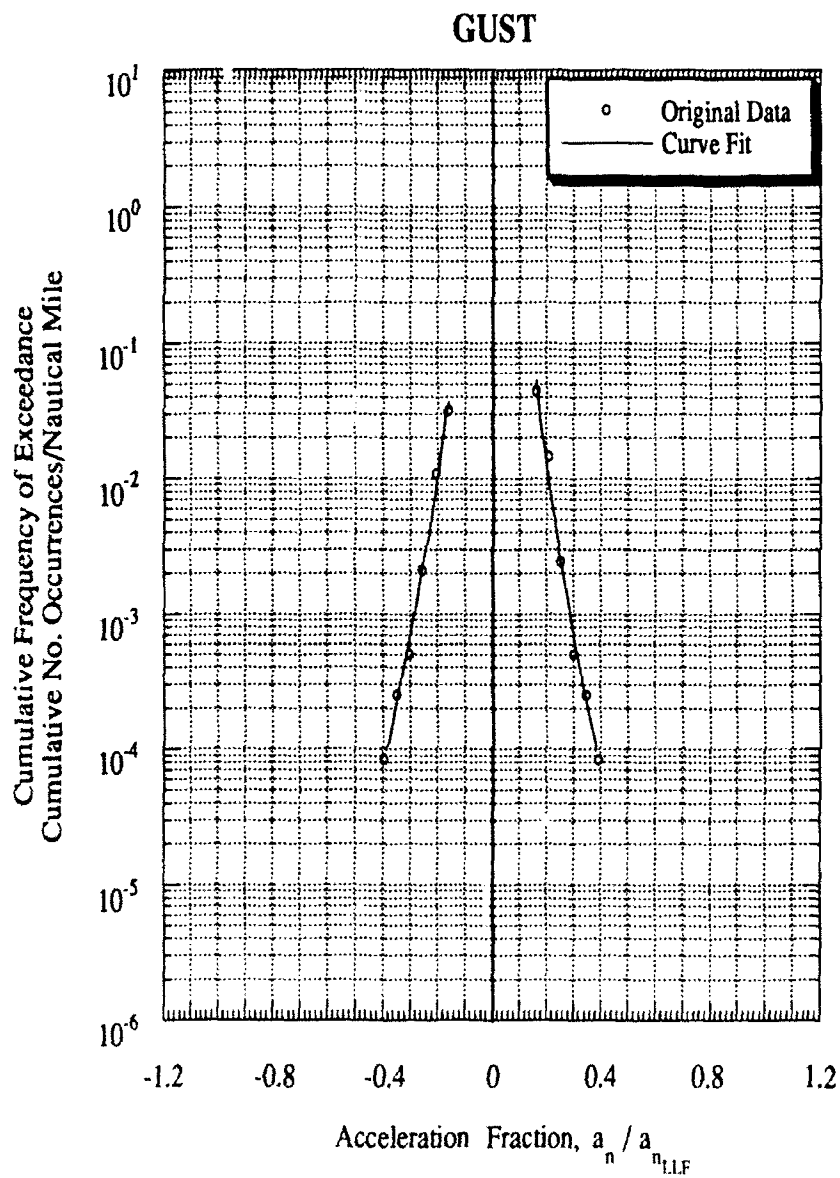
Curve fit for original data $(-0.350 < x < -0.162)$
$\log(y) = -5.582 - 4.447x^2 - 5.386\log(x)$

Curve fit for original data $(0.162 < x < 0.350)$
$\log(y) = -5.950 - 3.821x^2 - 6.032\log(x)$

Curve fit for original data $(-0.550 < x < -0.175)$
$\log(y) = -4.003 - 1.980x^2 - 3.299\log(x)$

Curve fit for original data $(0.175 < x < 1.550)$
$\log(y) = -1.658 - 0.555x^2 - 0.911\log(x)$
Curve fit for extrapolation $(1.550 < x < 1.675)$
$\log(y) = -0.102 - 1.976x$

Figure C-91 Load Spectra for Airplane 24, Large Airplanes, Special Usage



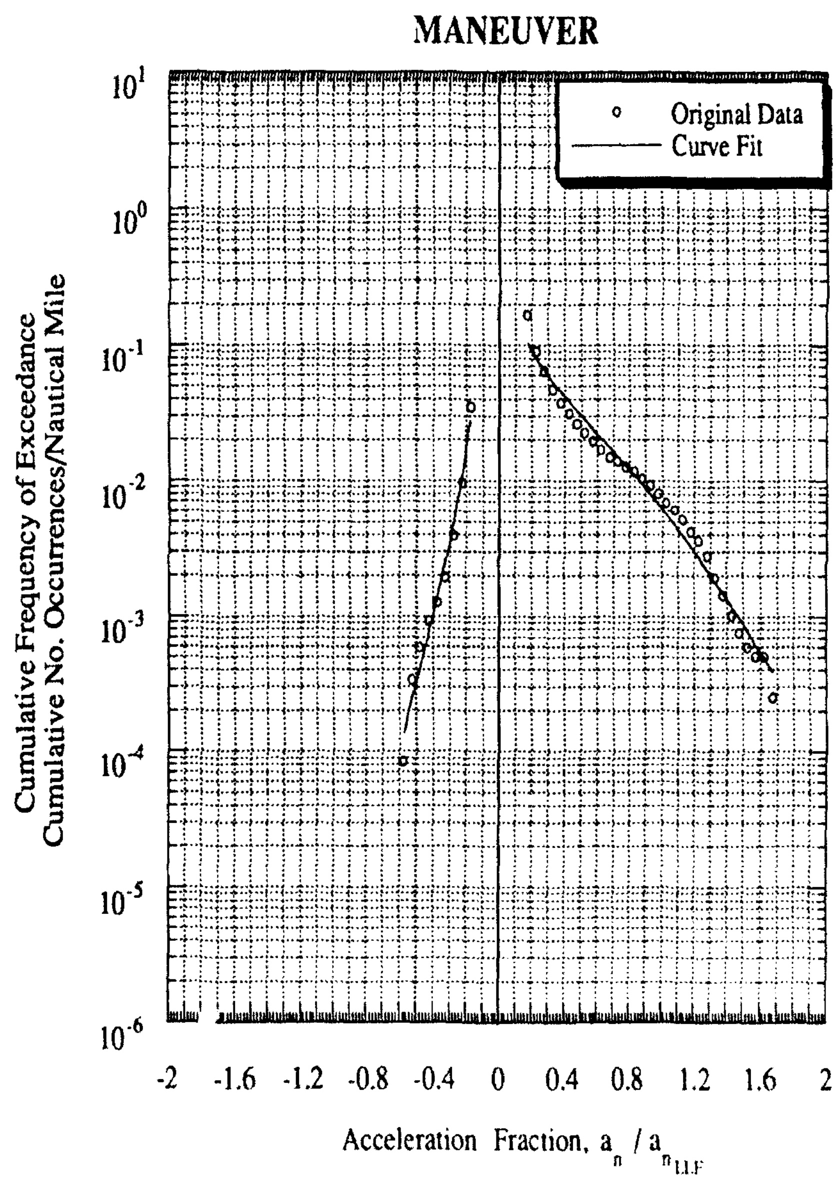


Table C-92 Tabulated Data for Airplane 24[1]

Total Nautical Miles = 13597 Total Hours = 92

GUST				MANEUVER			
negative		positive		negative		positive	
Acceleration Fraction	Cumulative Frequency of Exceedance	Acceleration Fraction	Cumulative Frequency of Exceedance	Acceleration Fraction	Cumulative Frequency of Exceedance	Acceleration Fraction	Cumulative Frequency of Exceedance
-0.150	0.0146542	0.150	0.0290371	-0.200	0.0114585	0.200	0.0596310
-0.200	0.0039039	0.200	0.0062188	-0.250	0.0047637	0.250	0.0458656
-0.250	0.0006339	0.250	0.0017217	-0.300	0.0021576	0.300	0.0364283
		0.300	0.0005505	-0.350	0.0010237	0.350	0.0295008
		0.350	0.0001914	-0.400	0.0004970	0.400	0.0241764
				-0.450	0.0002432	0.450	0.0199524
				-0.500	0.0001190	0.500	0.0165274
						0.550	0.0137083
						0.600	0.0113651
						0.650	0.0094059
						0.700	0.0077626
						0.750	0.0063833
						0.800	0.0052267
						0.850	0.0042591
						0.900	0.0034523
						0.950	0.0027827
						1.000	0.0022296
						1.050	0.0017753
						1.100	0.0014045
						1.150	0.0011038
						1.200	0.0008615
						1.250	0.0006678
						1.300	0.0005139
						1.350	0.0003926
						1.400	0.0002978
						1.450	0.0002241
						1.500	0.0001681
						1.550	0.0001261
						1.600	0.9454E-04
						1.650	0.7090E-04

NOTE: for curve fits $x = |x|$

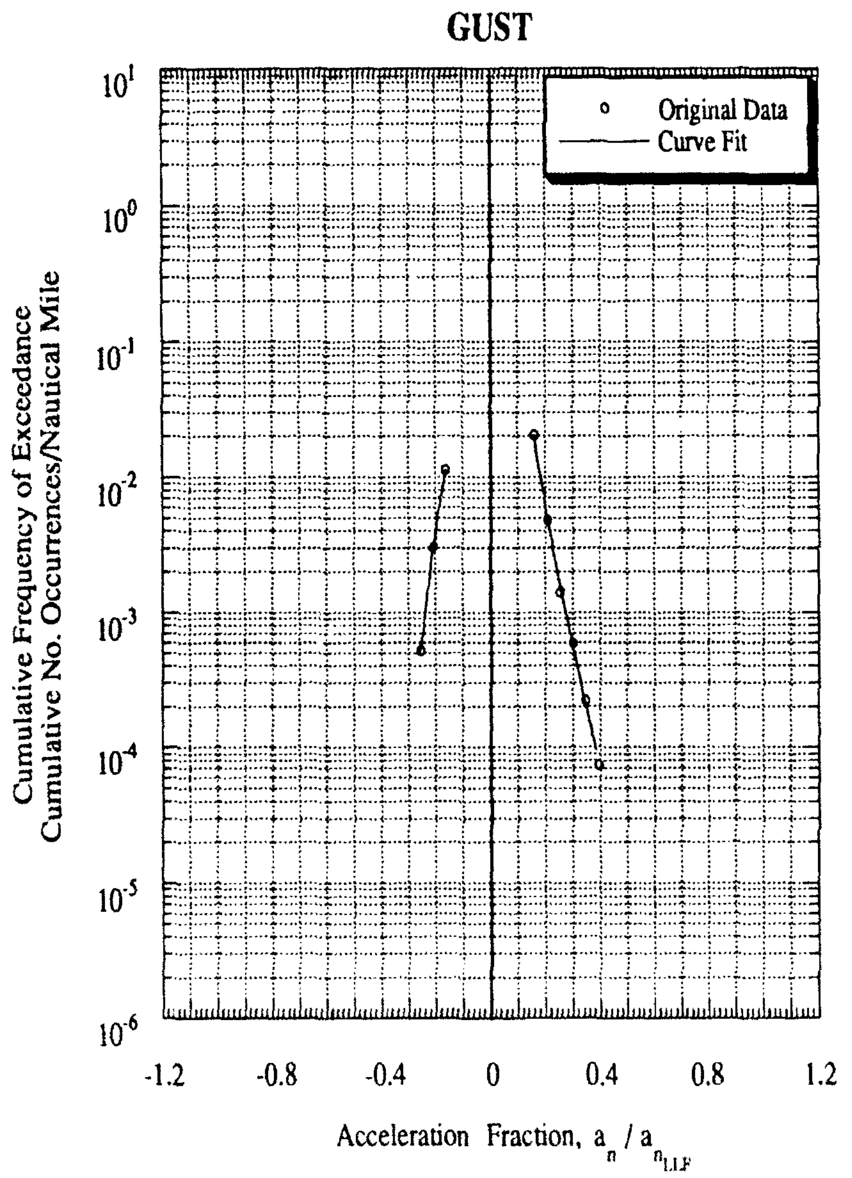
Curve fit for original data ($-0.250 < x < -0.162$)
$\log(y) = -0.310 - 38.523x^2 + 0.798\log(x)$

Curve fit for original data ($0.162 < x < 0.350$)
$\log(y) = -5.353 - 4.330x^2 - 4.750\log(x)$

Curve fit for original data ($-0.450 < x < -0.175$)
$\log(y) = -3.969 - 3.566x^2 - 3.105\log(x)$
Curve fit for extrapolation ($-0.525 < x < -0.450$)
$\log(y) = -0.821 - 6.207x$

Curve fit for original data ($0.175 < x < 1.450$)
$\log(y) = -1.893 - 0.759x^2 - 1.000\log(x)$
Curve fit for extrapolation ($1.450 < x < 1.675$)
$\log(y) = -0.025 - 2.499x$

Figure C-92 Load Spectra for Airplane 24[1], Large Airplanes, Special Usage



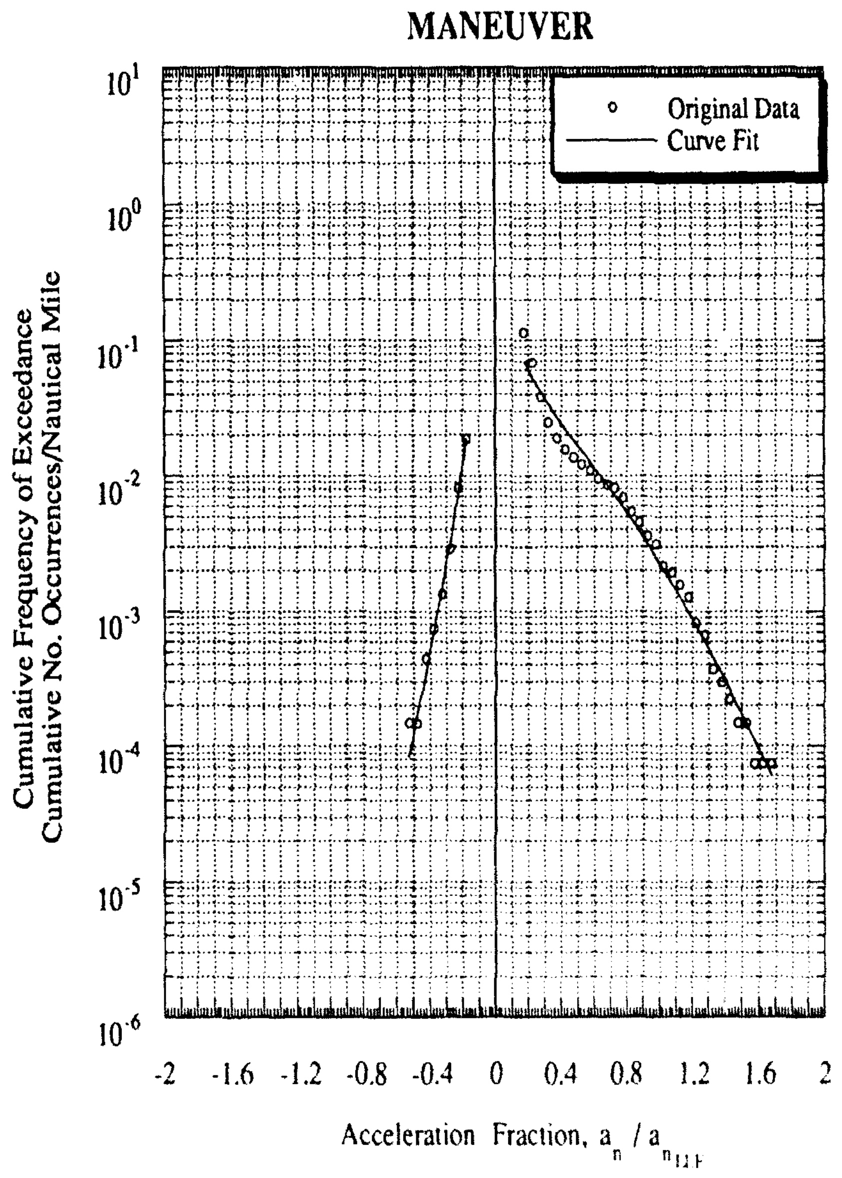


Table C-93 Tabulated Data for Airplane 24[2]

Total Nautical Miles = 10222 Total Hours = 67

GUST				MANEUVER			
negative		positive		negative		positive	
Acceleration Fraction	Cumulative Frequency of Exceedance	Acceleration Fraction	Cumulative Frequency of Exceedance	Acceleration Fraction	Cumulative Frequency of Exceedance	Acceleration Fraction	Cumulative Frequency of Exceedance
-0.150	0.0476588	0.150	0.0643354	-0.200	0.0101610	0.200	0.0604476
-0.200	0.0061376	0.200	0.0059809	-0.250	0.0030531	0.250	0.0343742
-0.250	0.0008323	0.250	0.0011477	-0.300	0.0010439	0.300	0.0239211
-0.300	0.0001072	0.300	0.0003623	-0.350	0.0003842	0.350	0.0187949
		0.350	0.0001667	-0.400	0.0001473	0.400	0.0158901
						0.450	0.0140144
						0.500	0.0126235
						0.550	0.0114390
						0.600	0.0103123
						0.650	0.0091707
						0.700	0.0079923
						0.750	0.0067904
						0.800	0.0056007
						0.850	0.0044692
						0.900	0.0034404
						0.950	0.0025488
						1.000	0.0018137
						1.050	0.0012374
						1.100	0.0008082
						1.150	0.0005048
						1.200	0.0003011

NOTE: for curve fits $x = |x|$

Curve fit for original data $(-0.300 < x < -0.162)$
$\log(y) = -4.453 - 19.858x^2 - 4.343\log(x)$
Curve fit for extrapolation $(-0.347 < x < -0.300)$
$\log(y) = 1.491 - 18.202x$

Curve fit for original data $(0.162 < x < 0.350)$
$\log(y) = -9.282 + 9.332x^2 - 9.565\log(x)$

Curve fit for original data $(-0.400 < x < -0.175)$
$\log(y) = -4.885 - 4.324x^2 - 4.385\log(x)$

Curve fit for original data $(0.175 \le x < 1.200)$
$\log(y) = -7.409 + 9.705x - 5.038x^2 - 6.367\log(x)$

Figure C-93 Load Spectra for Airplane 24², Large Airplanes, Special Usage

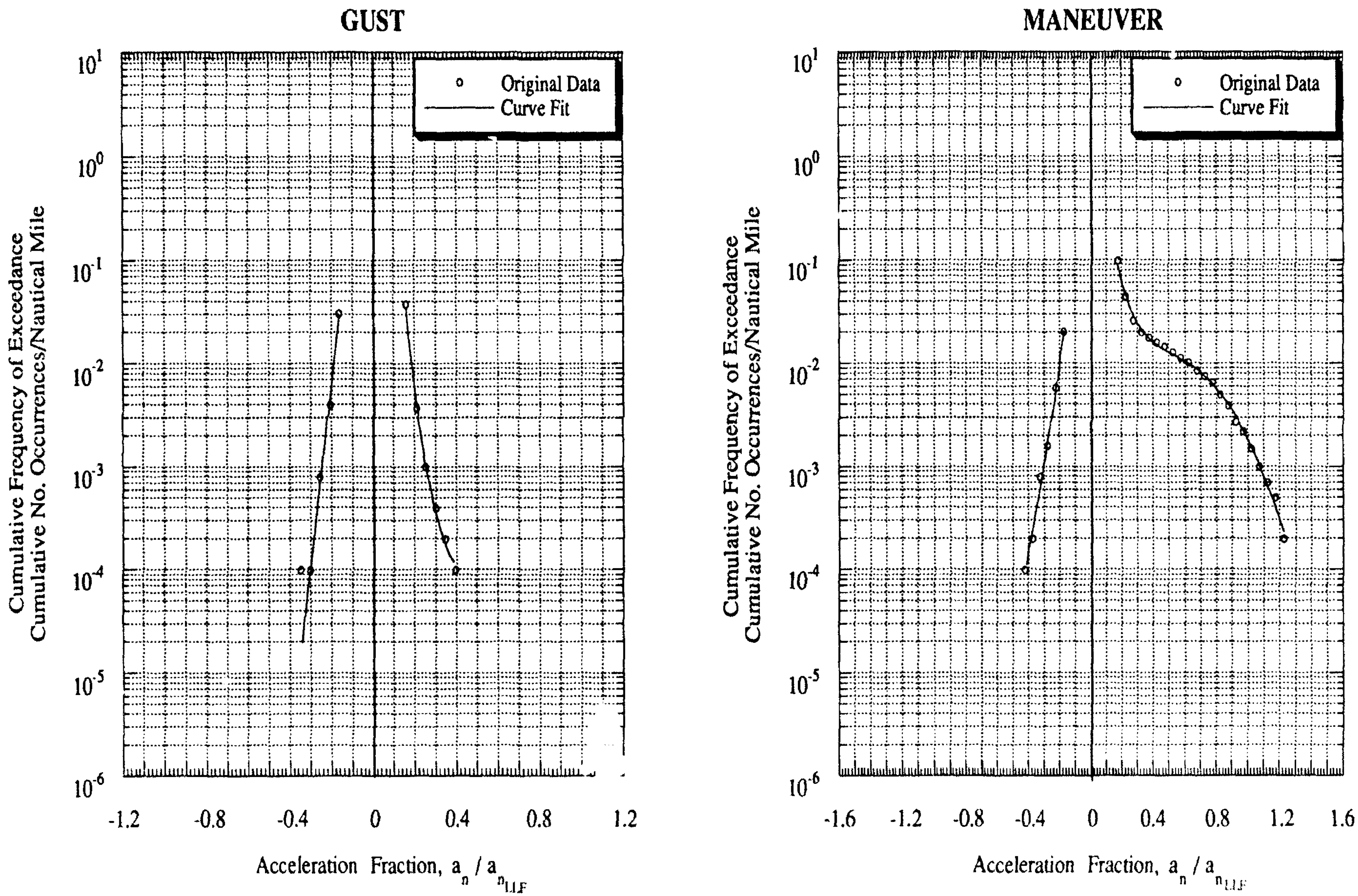


Table C-94 Tabulated Data for Airplane 24[3]

Total Nautical Miles = 10300 Total Hours = 67

GUST				MANEUVER			
negative		positive		negative		positive	
Acceleration Fraction	Cumulative Frequency of Exceedance	Acceleration Fraction	Cumulative Frequency of Exceedance	Acceleration Fraction	Cumulative Frequency of Exceedance	Acceleration Fraction	Cumulative Frequency of Exceedance
-0.150	0.0187288	0.150	0.0104400	-0.200	0.0239276	0.200	0.0493745
-0.200	0.0048204	0.200	0.0044116	-0.250	0.0104542	0.250	0.0369380
-0.250	0.0015501	0.250	0.0018681	-0.300	0.0052007	0.300	0.0288253
-0.300	0.0005643	0.300	0.0007616	-0.350	0.0028193	0.350	0.0231166
-0.350	0.0002206			-0.400	0.0016224	0.400	0.0188820
				-0.450	0.0009744	0.450	0.0156190
				-0.500	0.0006038	0.500	0.0130327
				-0.550	0.0003829	0.550	0.0109390
				-0.600	0.0002469	0.600	0.0092168
				-0.650	0.0001612	0.650	0.0077833
						0.700	0.0065796
						0.750	0.0055624
						0.800	0.0046991
						0.850	0.0039645
						0.900	0.0033384
						0.950	0.0028047
						1 000	0.0023500
						1.050	0.0019631
						1.100	0.0016345
						1.150	0.0013561
						1.200	0.0011210
						1.250	0.0009230
						1.300	0.0007568
						1.350	0.0006193
						1.400	0.0005068
						1.450	0.0004147

NOTE: for curve fits $x = |x|$

Curve fit for original data ($-0.350 < x < -0.162$)
$\log(y) = -5.065 - 3.981x^2 - 4.160\log(x)$

Curve fit for original data ($0.162 < x < 0.300$)
$\log(y) = -3.166 - 9.300x^2 - 1.692\log(x)$

Curve fit for original data ($-0.650 < x < -0.175$)
$\log(y) = -4.006 - 1.032x^2 - 3.471\log(x)$

Curve fit for original data ($0.175 < x < 1.300$)
$\log(y) = -2.111 - 0.518x^2 - 1.180\log(x)$
Curve fit for extrapolation ($1.300 < x < 1.475$)
$\log(y) = -0.857 - 1.742x$

Figure C-94 Load Spectra for Airplane 24[3], Large Airplanes, Special Usage

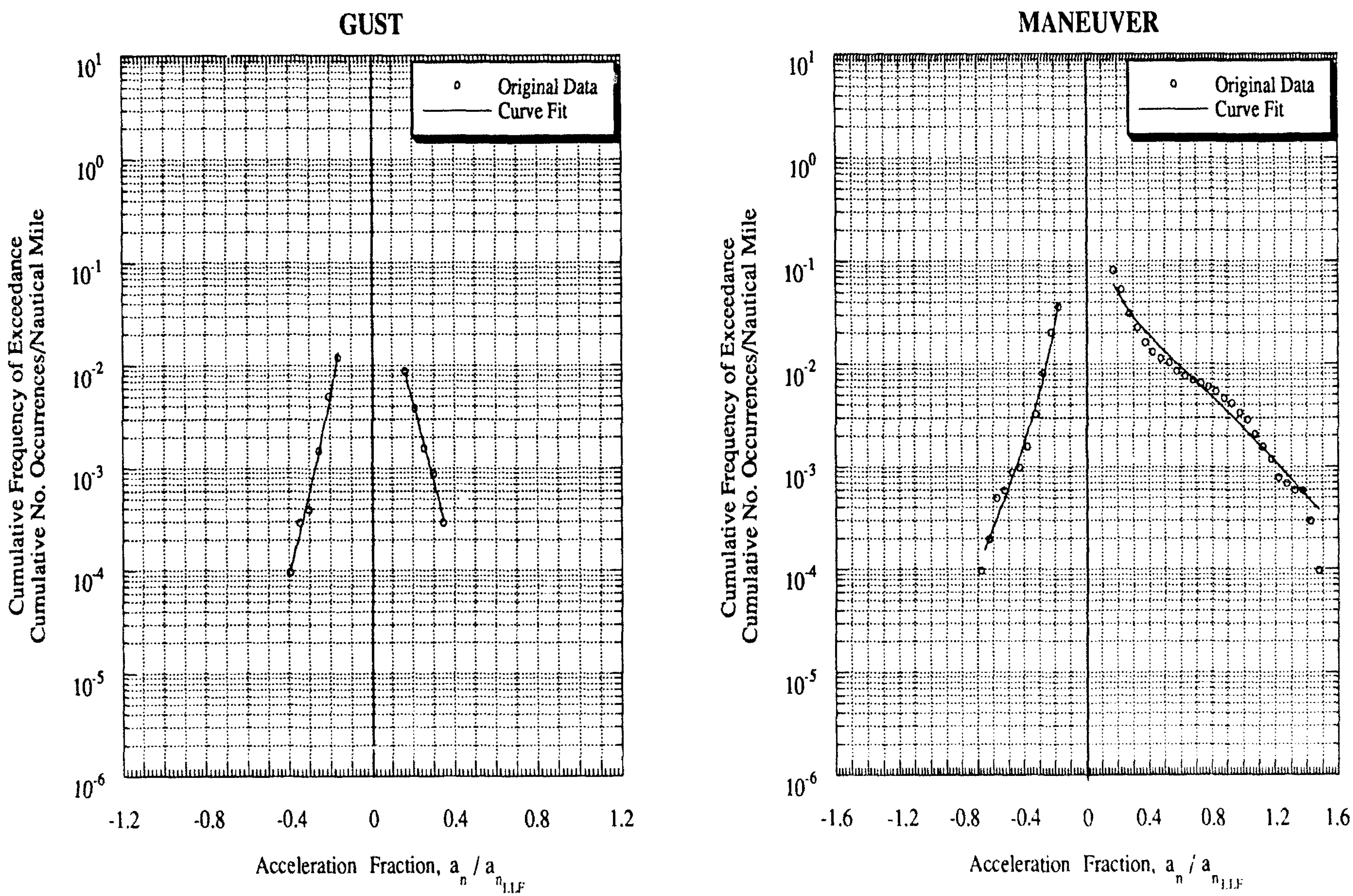


Table C-95 Tabulated Data for Airplane 24[4]

Total Nautical Miles = 16205 Total Hours = 101

GUST negative Acceleration Fraction	GUST negative Cumulative Frequency of Exceedance	GUST positive Acceleration Fraction	GUST positive Cumulative Frequency of Exceedance	MANEUVER negative Acceleration Fraction	MANEUVER negative Cumulative Frequency of Exceedance	MANEUVER positive Acceleration Fraction	MANEUVER positive Cumulative Frequency of Exceedance
-0.150	0.0122170	0.150	0.0324442	-0.200	0.0099618	0.200	0.0645494
-0.200	0.0063425	0.200	0.0165066	-0.250	0.0033191	0.250	0.0483608
-0.250	0.0023199	0.250	0.0075350	-0.300	0.0013471	0.300	0.0376141
-0.300	0.0006138	0.300	0.0030442	-0.350	0.0006261	0.350	0.0299425
		0.350	0.0010806	-0.400	0.0003211	0.400	0.0241893
		0.400	0.0003355	-0.450	0.0001775	0.450	0.0197232
				-0.500	0.0001041	0.500	0.0161707
				-0.550	0.6255E-04	0.550	0.0132958
						0.600	0.0109418
						0.650	0.0089990
						0.700	0.0073881
						0.750	0.0060492
						0.800	0.0049359
						0.850	0.0040113
						0.900	0.0032451
						0.950	0.0026122
						1.000	0.0020916
						1.050	0.0016654
						1.100	0.0013182
						1.150	0.0010370
						1.200	0.0008107
						1.250	0.0006297
						1.300	0.0004858
						1.350	0.0003723
						1.400	0.0002833
						1.450	0.0002149
						1.500	0.0001630
						1.550	0.0001236
						1.600	0.9375E-04

NOTE: for curve fits $x = |x|$

Curve fit for original data ($-0.300 < x < -0.162$)
$\log(y) = -0.454 - 24.194x^2 + 1.110\log(x)$

Curve fit for original data ($0.162 < x < 0.400$)
$\log(y) = -1.679 - 12.653x^2 - 0.577\log(x)$

Curve fit for original data ($-0.500 < x < -0.175$)
$\log(y) = -5.408 - 0.179x^2 - 4.884\log(x)$
Curve fit for extrapolation ($-0.575 < x < -0.500$)
$\log(y) = -1.772 - 4.421x$

Curve fit for original data ($0.175 < x < 1.400$)
$\log(y) = -1.946 - 0.733x^2 - 1.124\log(x)$
Curve fit for extrapolation ($1.400 < x < 1.625$)
$\log(y) = -0.185 - 2.402x$

Table C-96 Tabulated Data for Airplane 24[5]

Total Nautical Miles = 12302 Total Hours = 86

GUST				MANEUVER			
negative		positive		negative		positive	
Acceleration Fraction	Cumulative Frequency of Exceedance	Acceleration Fraction	Cumulative Frequency of Exceedance	Acceleration Fraction	Cumulative Frequency of Exceedance	Acceleration Fraction	Cumulative Frequency of Exceedance
-0.150	0.0359470	0.150	0.0191206	-0.200	0.0277413	0.200	0.0458279
-0.200	0.0193755	0.200	0.0047058	-0.250	0.0141000	0.250	0.0311025
-0.250	0.0088260	0.250	0.0012081	-0.300	0.0066901	0.300	0.0221972
-0.300	0.0033933	0.300	0.0003012	-0.350	0.0029296	0.350	0.0163435
-0.350	0.0011003			-0.400	0.0011760	0.400	0.0122741
-0.400	0.0003008			-0.450	0.0004308	0.450	0.0093334
				-0.500	0.0001436	0.500	0.0071502
				-0.550	0.4562E-04	0.550	0.0054987
				-0.600	0.1449E-04	0.600	0.0042339
				-0.650	0.4605E-05	0.650	0.0032573
				-0.700	0.1463E-05	0.700	0.0025001
						0.750	0.0019120
						0.800	0.0014556
						0.850	0.0011021
						0.900	0.0008294
						0.950	0.0006201
						1.000	0.0004603
						1.050	0.0003391
						1.100	0.0002478
						1.150	0.0001797
						1.200	0.0001292

NOTE: for curve fits x = |x|

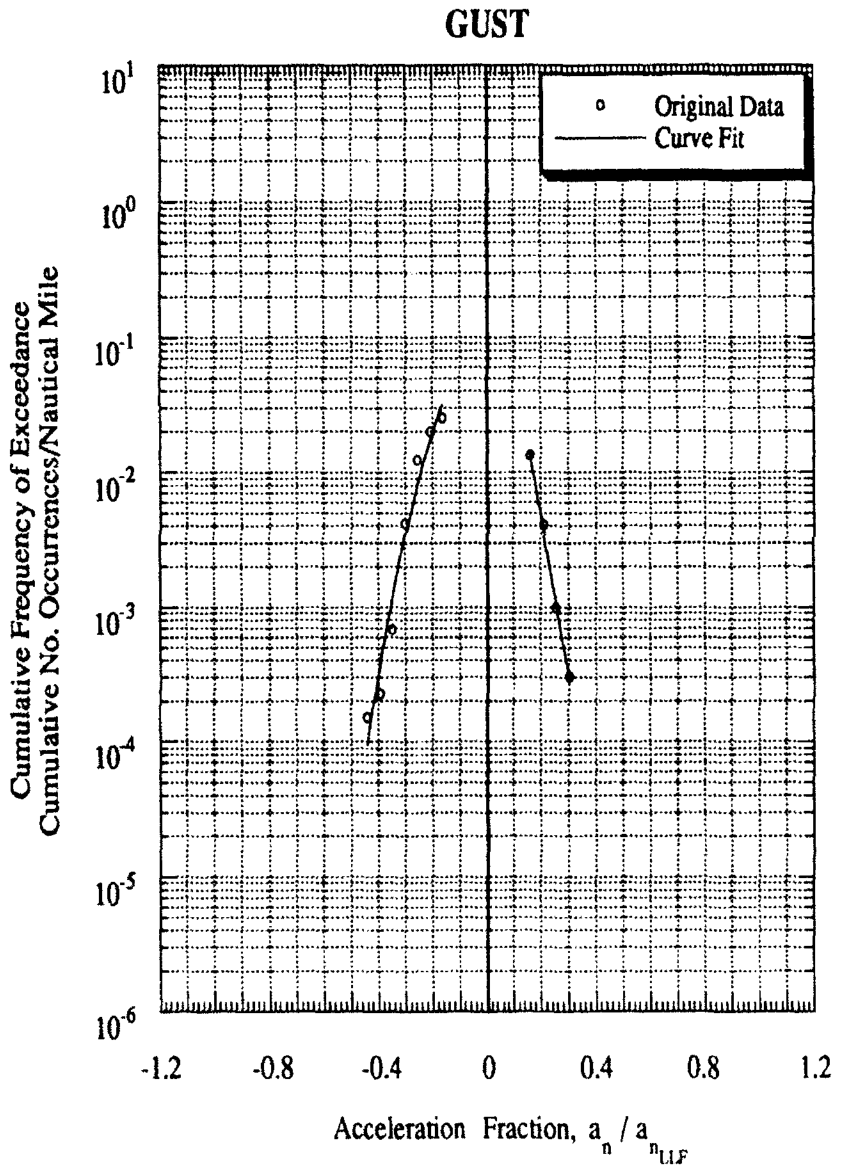
Curve fit for original data ($-0.400 < x < -0.162$)
$\log(y) = -1.155 - 14.933x^2 - 0.057\log(x)$

Curve fit for original data ($0.162 < x < 0.300$)
$\log(y) = -3.907 - 13.248x^2 - 3.018\log(x)$

Curve fit for original data ($-0.500 < x < -0.175$)
$\log(y) = -1.821 - 9.175x^2 - 0.903\log(x)$
Curve fit for extrapolation ($-0.725 < x < -0.500$)
$\log(y) = 1.137 - 9.959x$

Curve fit for original data ($0.175 < x < 1.200$)
$\log(y) = -2.354 - 0.983x^2 - 1.509\log(x)$

Figure C-96 Load Spectra for Airplane 24[5], Large Airplanes, Special Usage



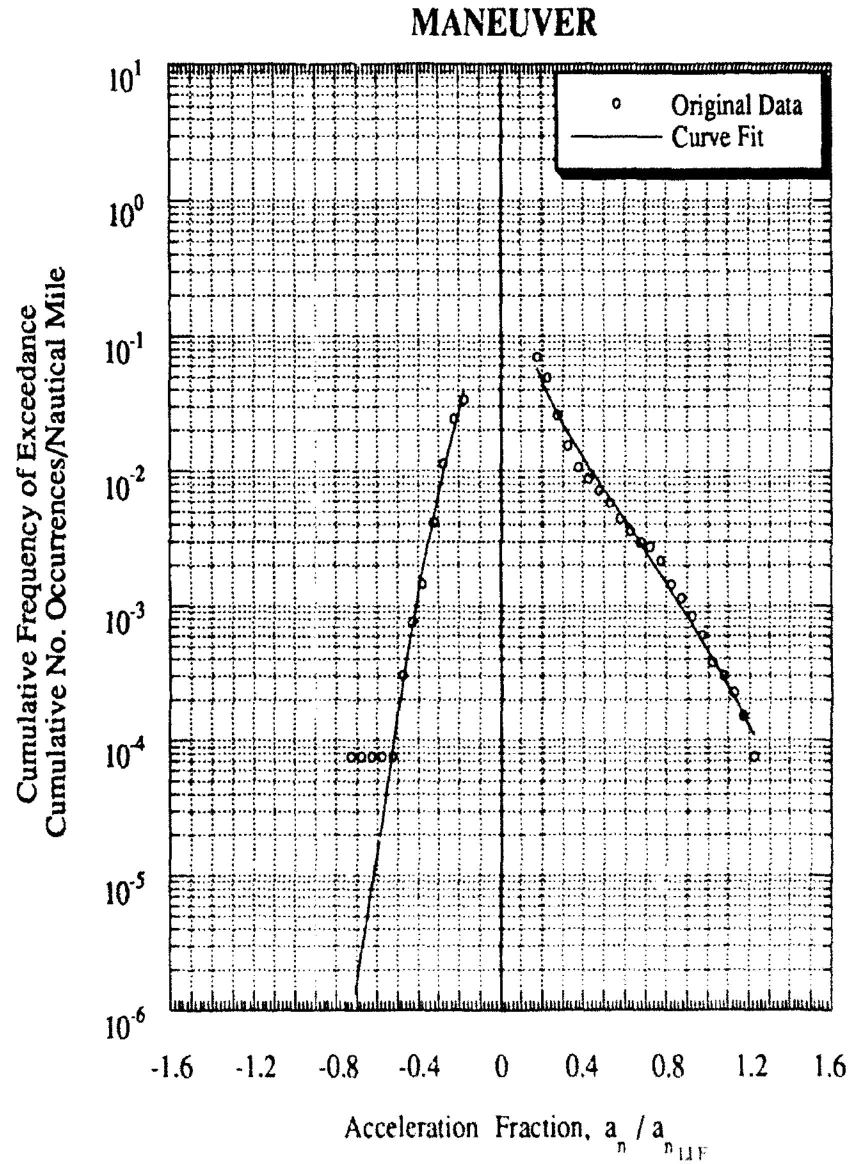


Table C-97 Tabulated Data for Airplane 38

Total Nautical Miles = 35333 Total Hours = 453

GUST negative Acceleration Fraction	GUST negative Cumulative Frequency of Exceedance	GUST positive Acceleration Fraction	GUST positive Cumulative Frequency of Exceedance	MANEUVER negative Acceleration Fraction	MANEUVER negative Cumulative Frequency of Exceedance	MANEUVER positive Acceleration Fraction	MANEUVER positive Cumulative Frequency of Exceedance
-0.150	0.0594127	0.150	0.1110776	-0.150	0.3193012	0.100	0.5690045
-0.200	0.0106358	0.200	0.0328002	-0.200	0.1470115	0.150	0.3334716
-0.250	0.0027134	0.250	0.0124280	-0.250	0.0741132	0.200	0.2540249
-0.300	0.0008604	0.300	0.0054857	-0.300	0.0388966	0.250	0.2149704
-0.350	0.0003153	0.350	0.0026791	-0.350	0.0206872	0.300	0.1884491
-0.400	0.0001278	0.400	0.0014038	-0.400	0.0109721	0.350	0.1648617
-0.450	0.5576E-04	0.450	0.0007737	-0.450	0.0057434	0.400	0.1407617
-0.500	0.2505E-04	0.500	0.0004425	-0.500	0.0029463	0.450	0.1156247
-0.550	0.1125E-04	0.550	0.0002601	-0.550	0.0014737	0.500	0.0904813
-0.600	0.5055E-05	0.600	0.0001560	-0.600	0.0007160	0.550	0.0669840
-0.650	0.2271E-05	0.650	0.9431E-04	-0.650	0.0003370	0.600	0.0466707
-0.700	0.1020E-05	0.700	0.5702E-04	-0.700	0.0001533	0.650	0.0304842
		0.750	0.3448E-04	-0.750	0.6853E-04	0.700	0.0186097
		0.800	0.2085E-04	-0.800	0.3063E-04	0.750	0.0105922
		0.850	0.1260E-04	-0.850	0.1369E-04	0.800	0.0056101
						0.850	0.0027606
						0.900	0.0012604
						0.950	0.0005333
						1.000	0.0002090
						1.050	0.7575E-04

NOTE: for curve fits x = |x|

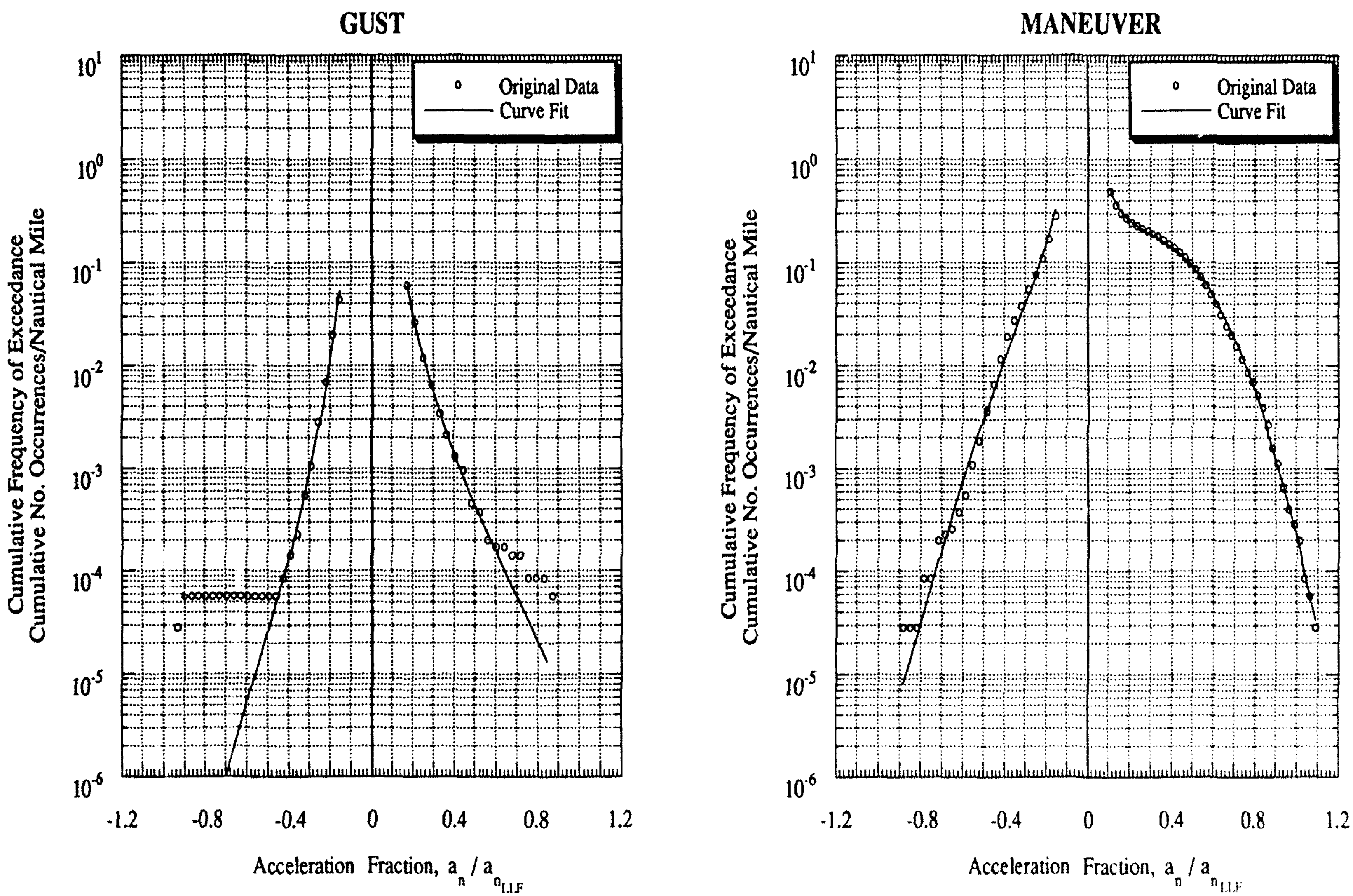
Curve fit for original data (-0.450 < x < -0.153)
$\log(y) = -5.940 - 1.542x^2 - 5.764\log(x)$
Curve fit for extrapolation (-0.932 < x < -0.450)
$\log(y) = -1.126 - 6.950x$

Curve fit for original data (0.174 < x < 0.600)
$\log(y) = -4.285 - 1.184x^2 - 4.074\log(x)$
Curve fit for extrapolation (0.600 < x < 0.872)
$\log(y) = -1.185 - 4.370x$

Curve fit for original data (-0.700 < x < -0.150)
$\log(y) = -2.158 - 4.053x^2 - 2.128\log(x)$
Curve fit for extrapolation (-0.883 < x < -0.700)
$\log(y) = 1.082 - 6.994x$

Curve fit for original data (0.113 ≤ x < 1.050)
$\log(y) = -3.879 + 7.593x - 7.393x^2 - 2.949\log(x)$

Figure C-97 Load Spectra for Airplane 38, Aerobatic Airplane



APPENDIX D:

STATISTICAL ANALYSIS

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Load Spectra Plots

Statistical Group	Gust Page	Maneuver Page
1A. Single-Engine, Basic Flight Instruction	D-3	D-4
1B. Single-Engine, Business/Personal	D-5	D-6
1A. and 1B. Single Engine, General Usage	D-7	D-8
2. Single-Engine, Special Usage	D-9	D-10
3. Aerial Application	D-11	D-12
4. Twin-Engine, General Usage	D-13	D-14
5. Twin-Engine, Special Usage	D-15	D-16
2. and 5. Single and Twin-Engine, Special Usage	D-17	D-18
6. Pressurized, General Usage	D-19	D-20

Statistical Methods and Equations D-21

Figure D-1 Gust Load Spectra: Single-Engine General Usage, Basic Flight Instruction

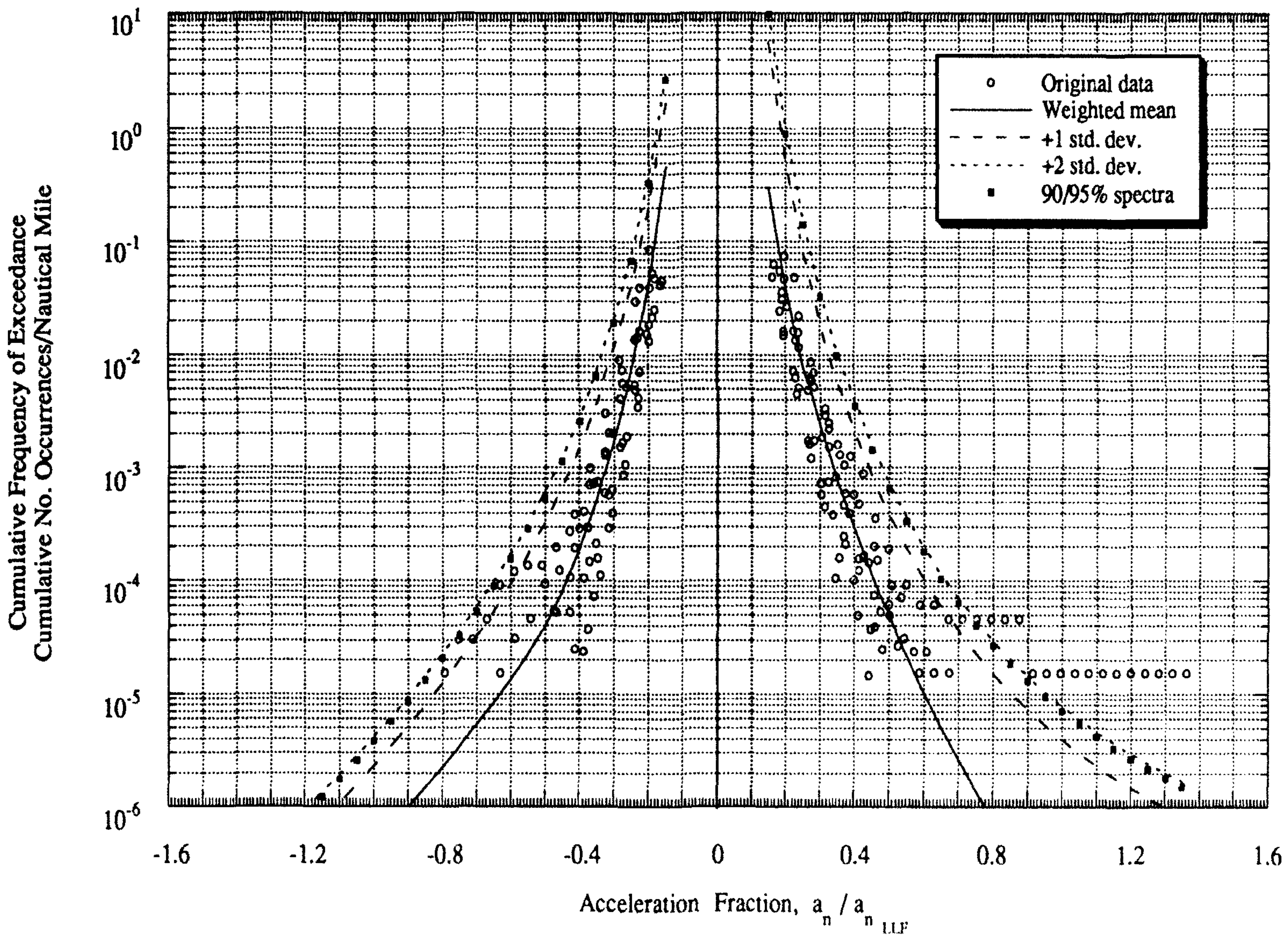


Figure D-2 Maneuver Load Spectra: Single-Engine General Usage, Basic Flight Instruction

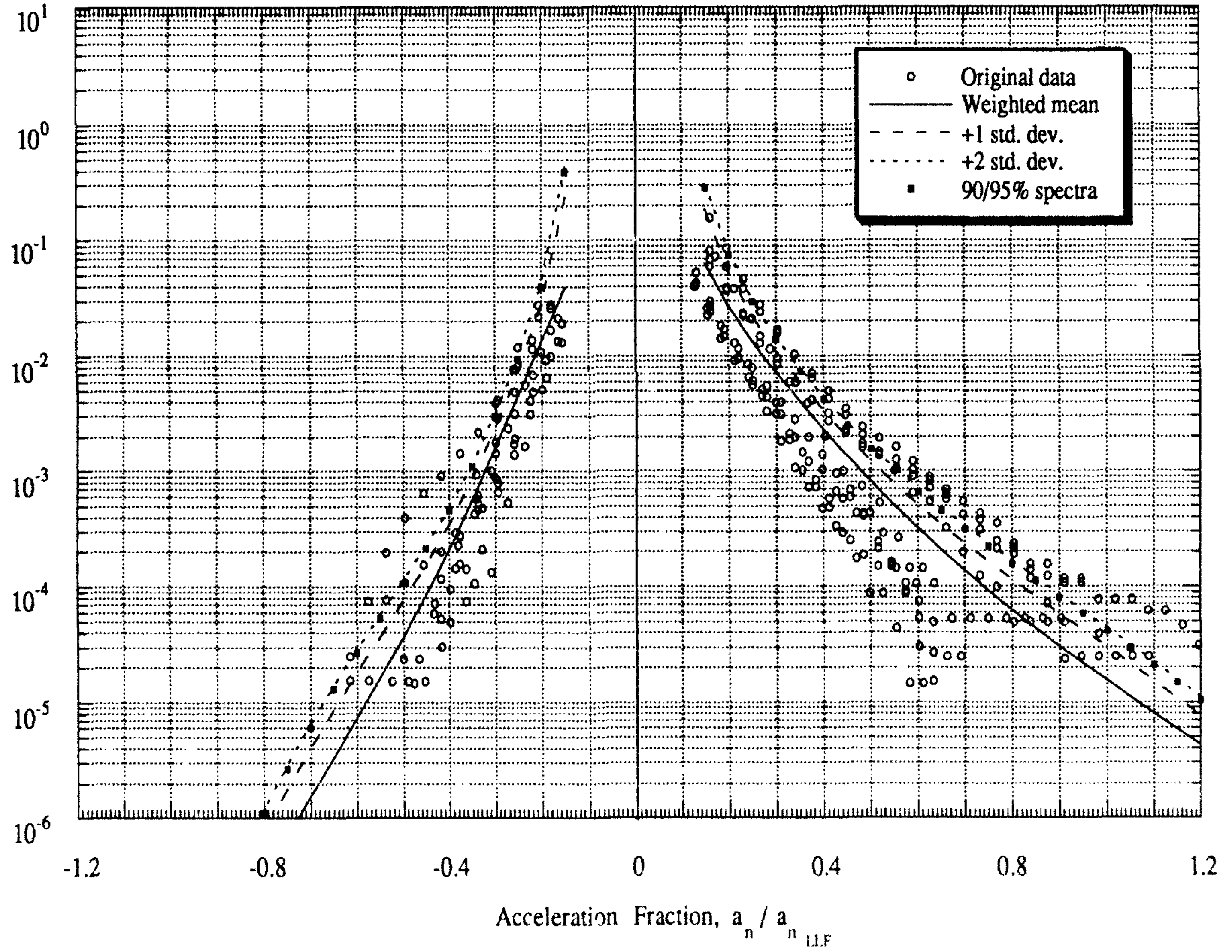


Figure D-3 Gust Load Spectra: Single-Engine General Usage, Business/Personal

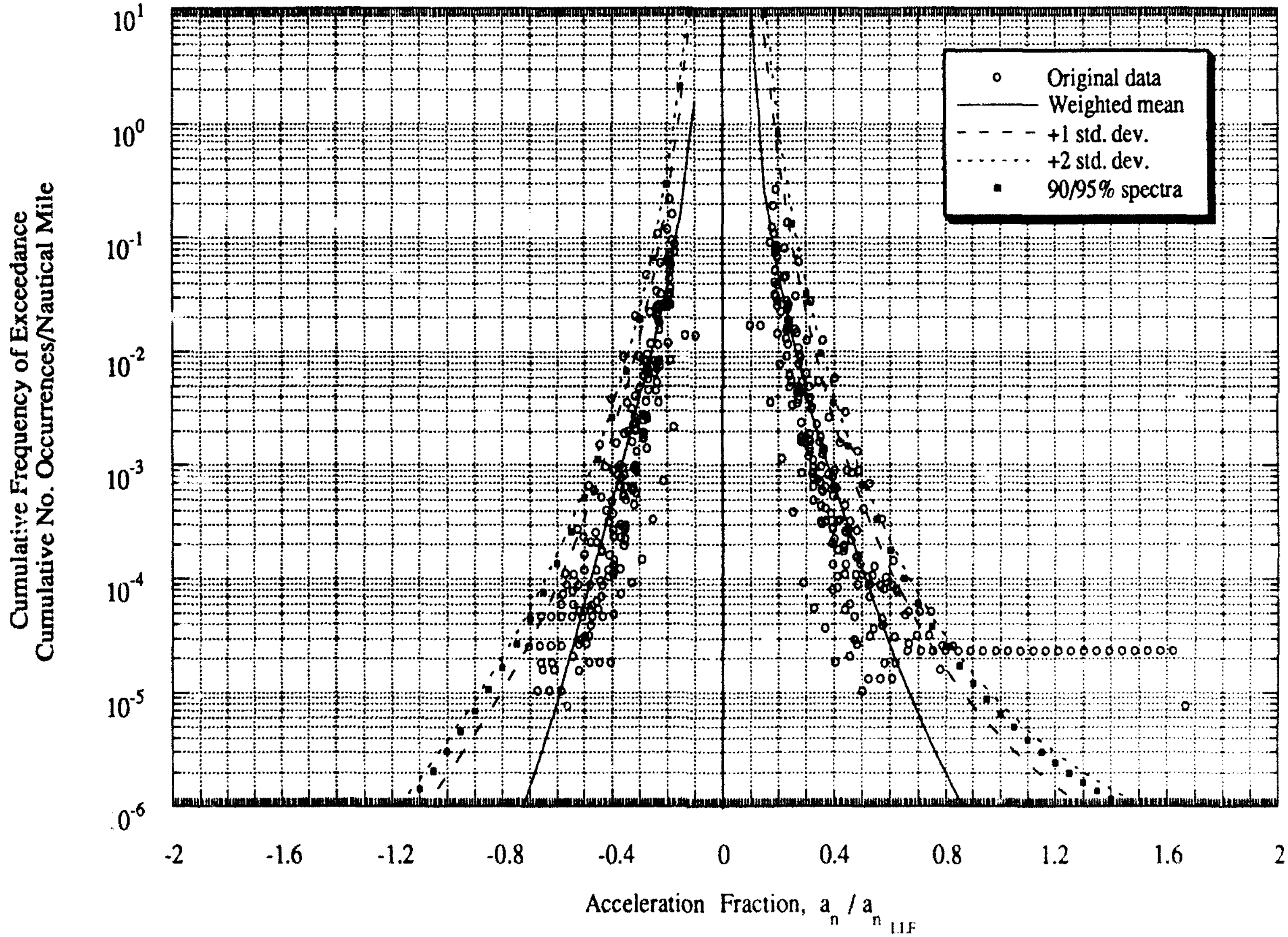


Figure D-4 Maneuver Load Spectra: Single-Engine General Usage, Business/Personal

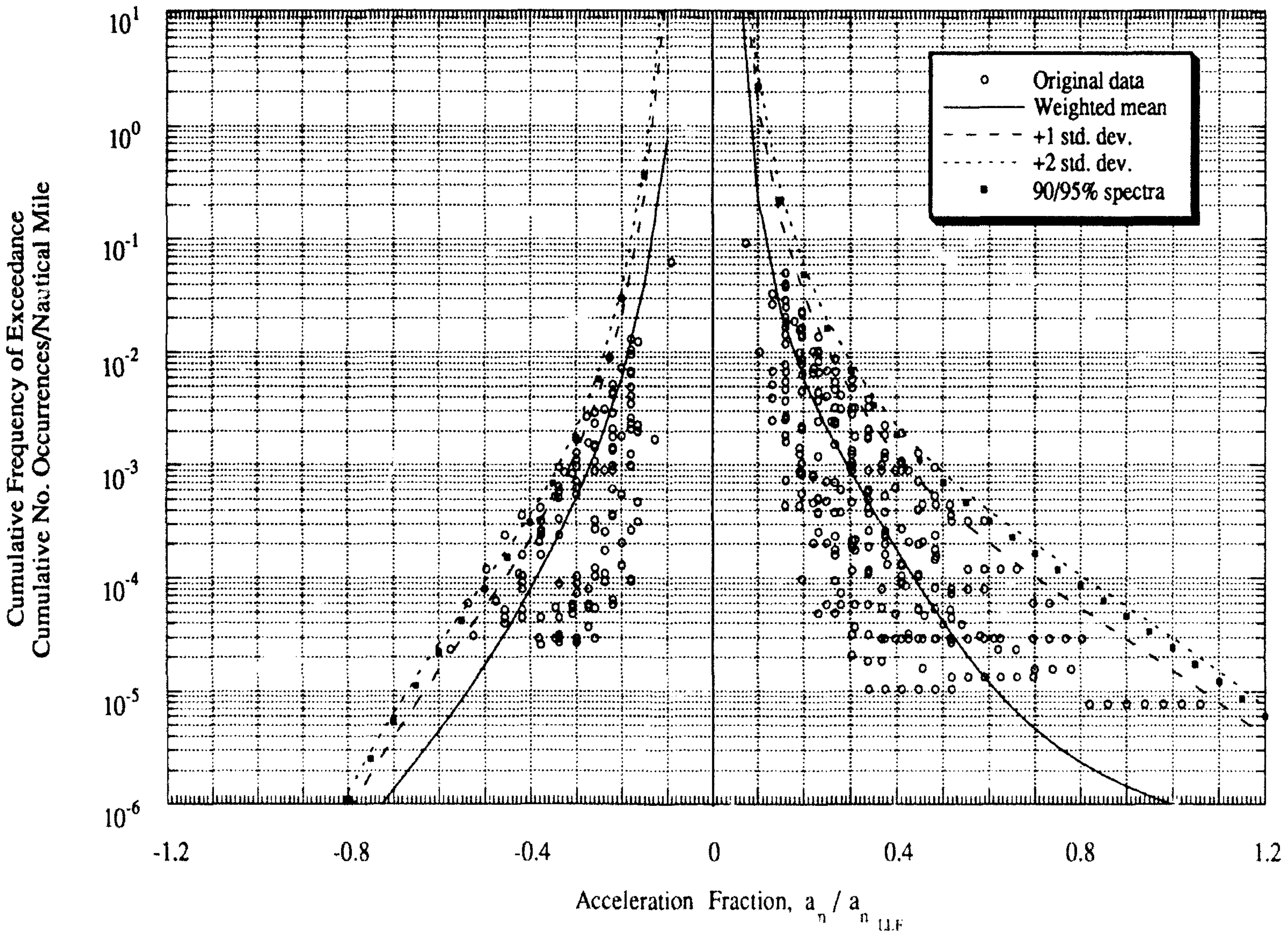


Figure D-5 Gust Load Spectra: Single Engine General Usage
(Basic Flight Instruction and Business/Personal Combined)

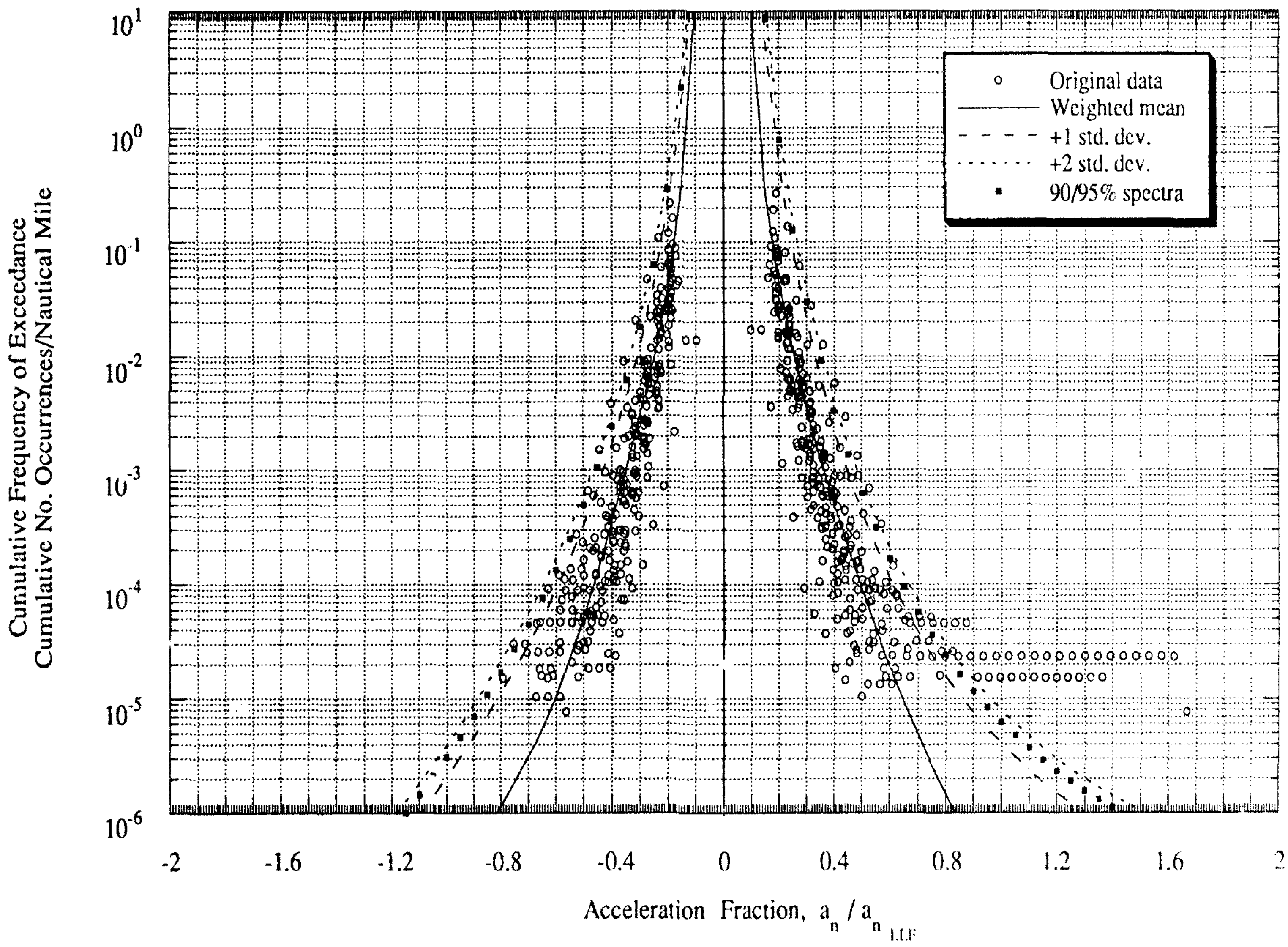


Figure D-6 Maneuver Load Spectra: Single-Engine General Usage
(Basic Flight Instruction and Business/Personal Combined)

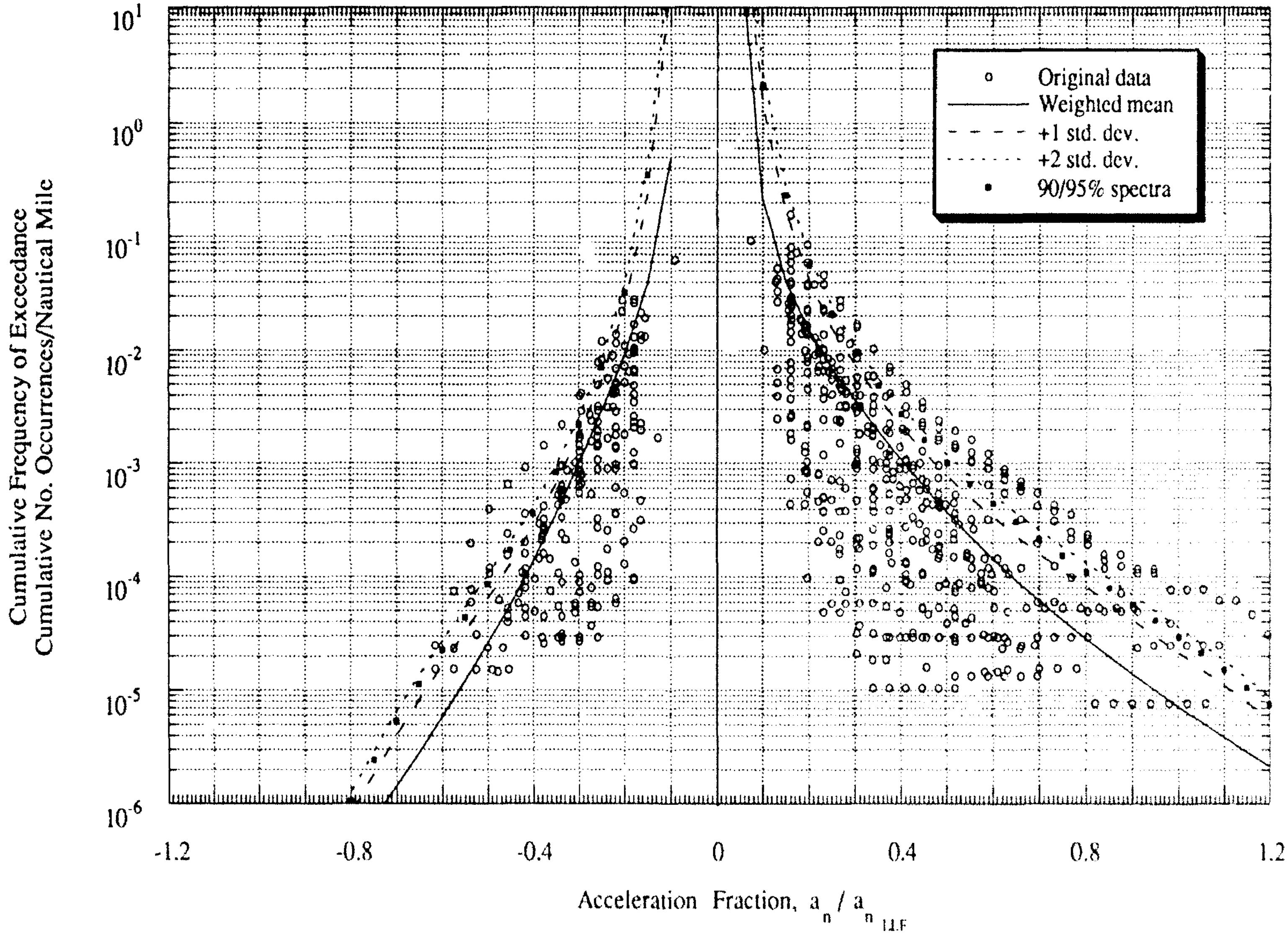


Figure D-7 Gust Load Spectra: Single-Engine Special Usage

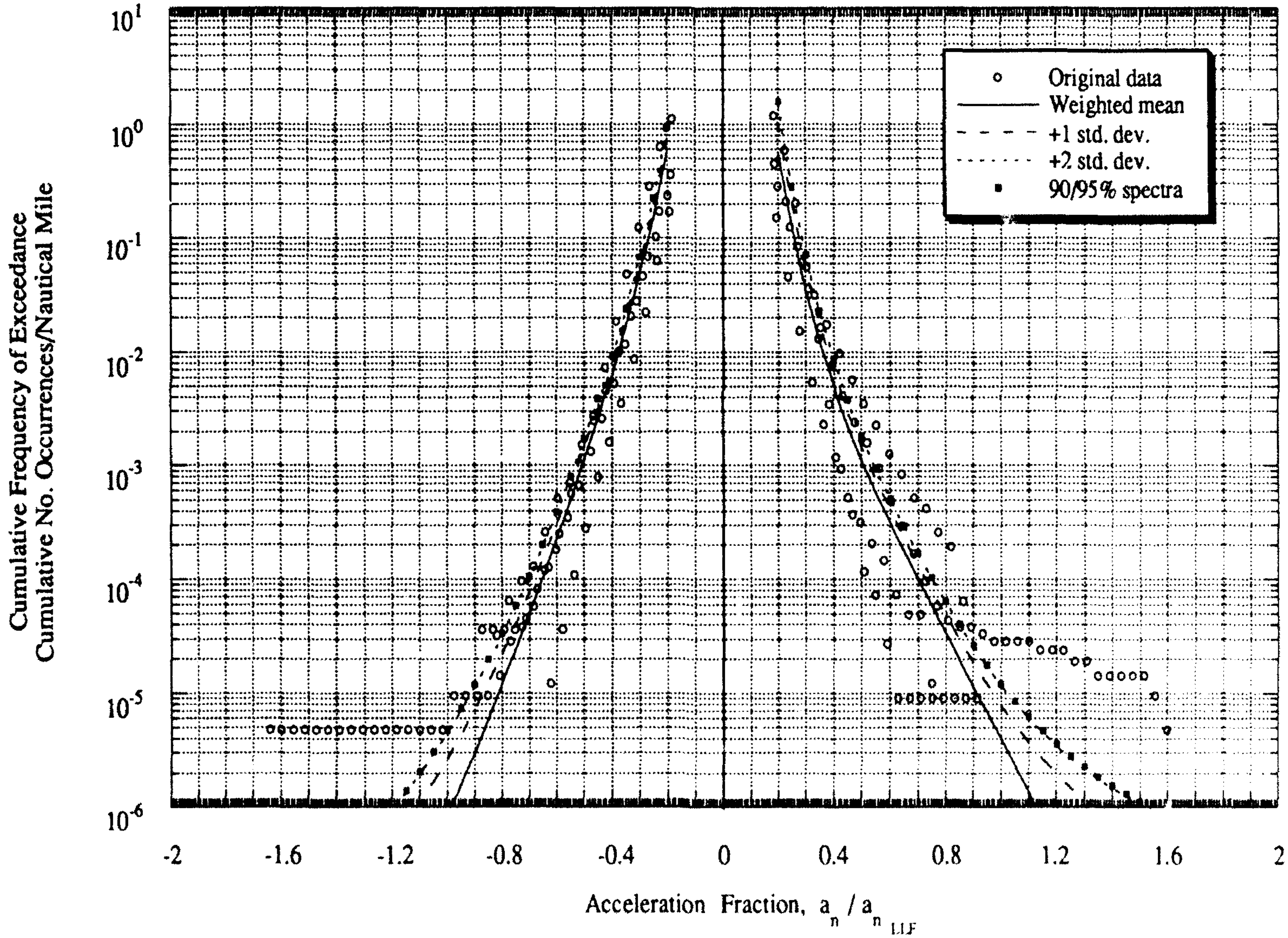


Figure D-8 Maneuver Load Spectra: Single-Engine Special Usage

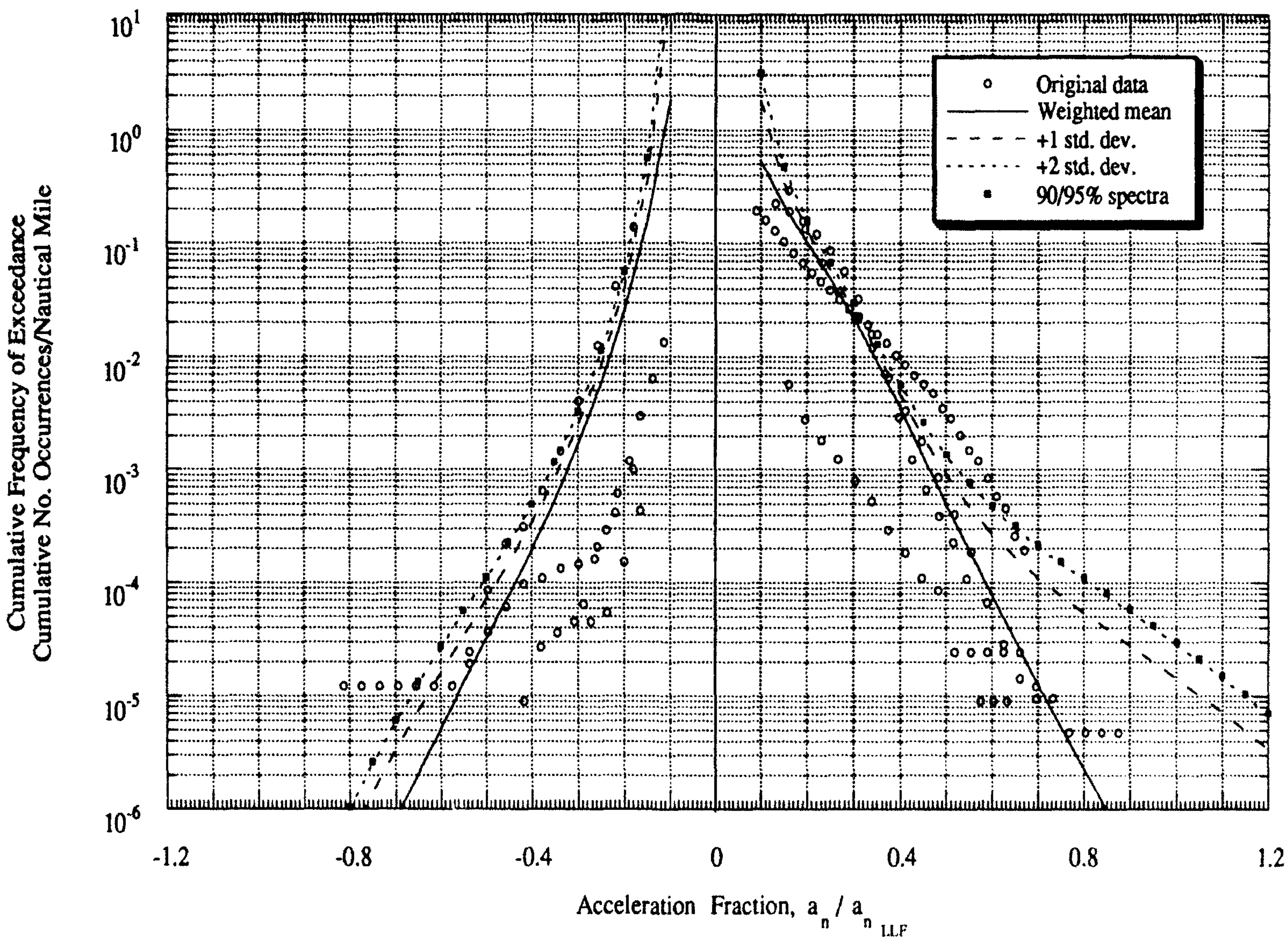


Figure D-9 Gust Load Spectra: Single-Engine Aerial Application

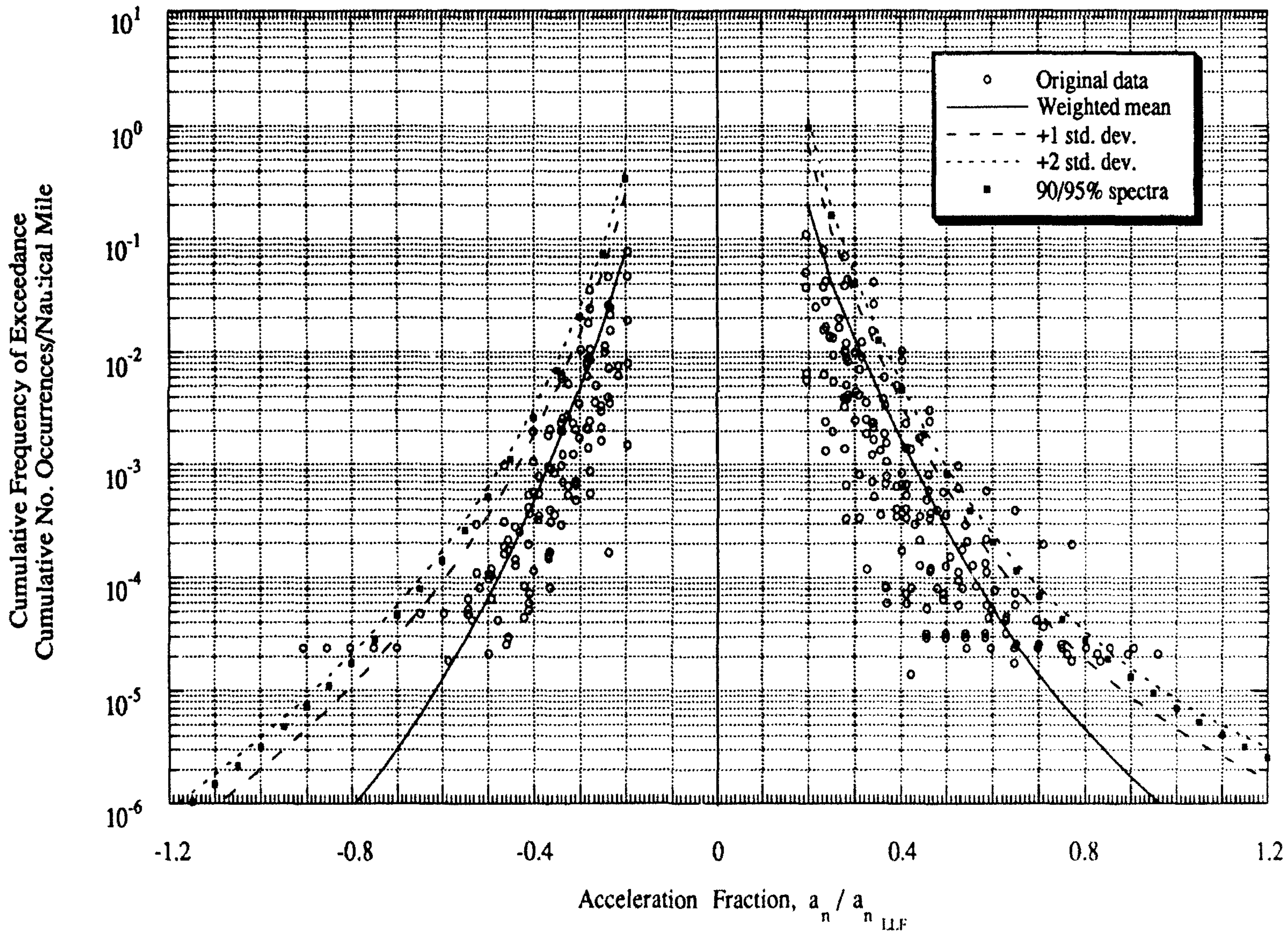


Figure D-10 Maneuver Load Spectra: Single-Engine Aerial Application

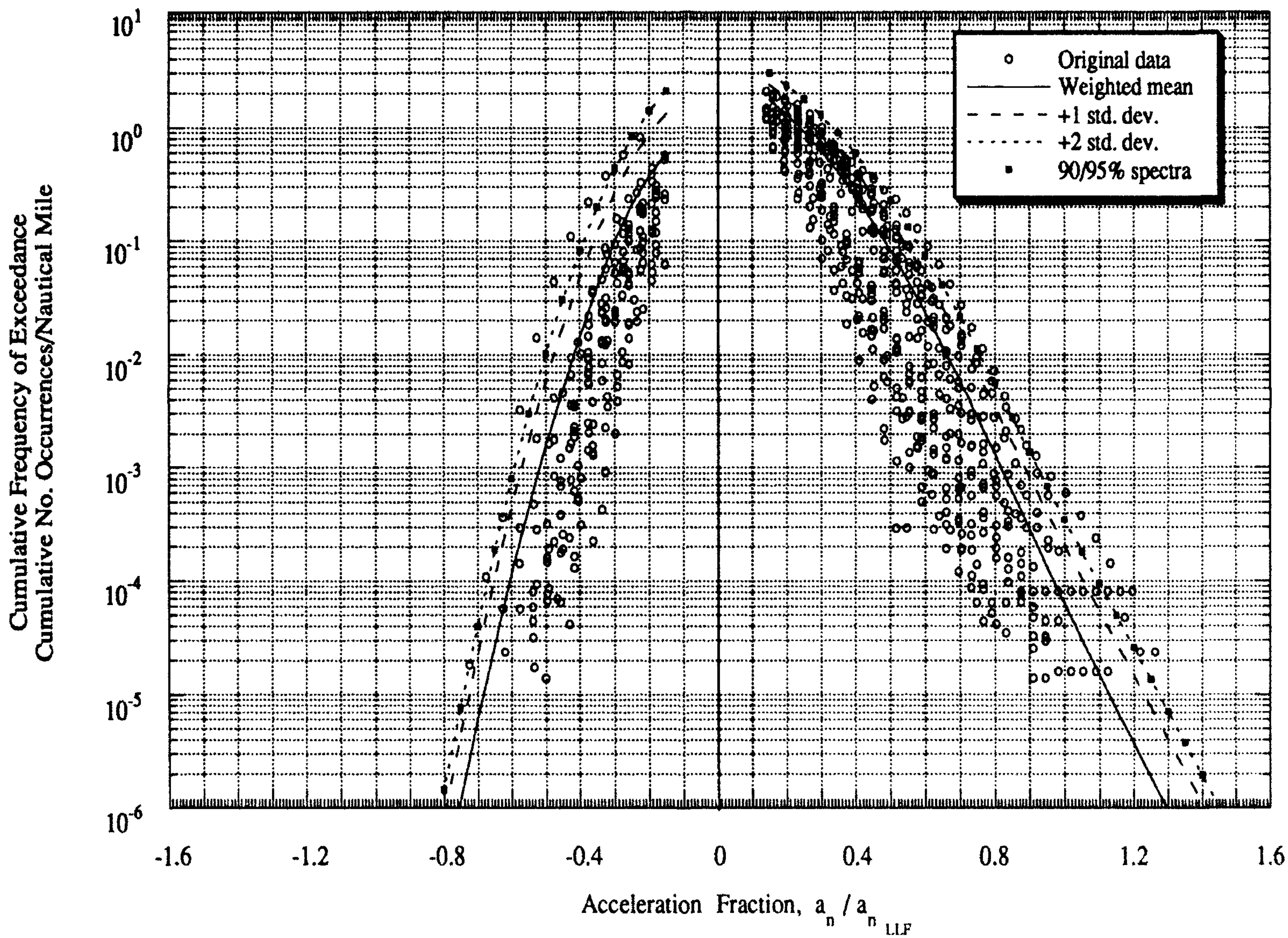


Figure D-11 Gust Load Spectra: Twin-Engine General Usage

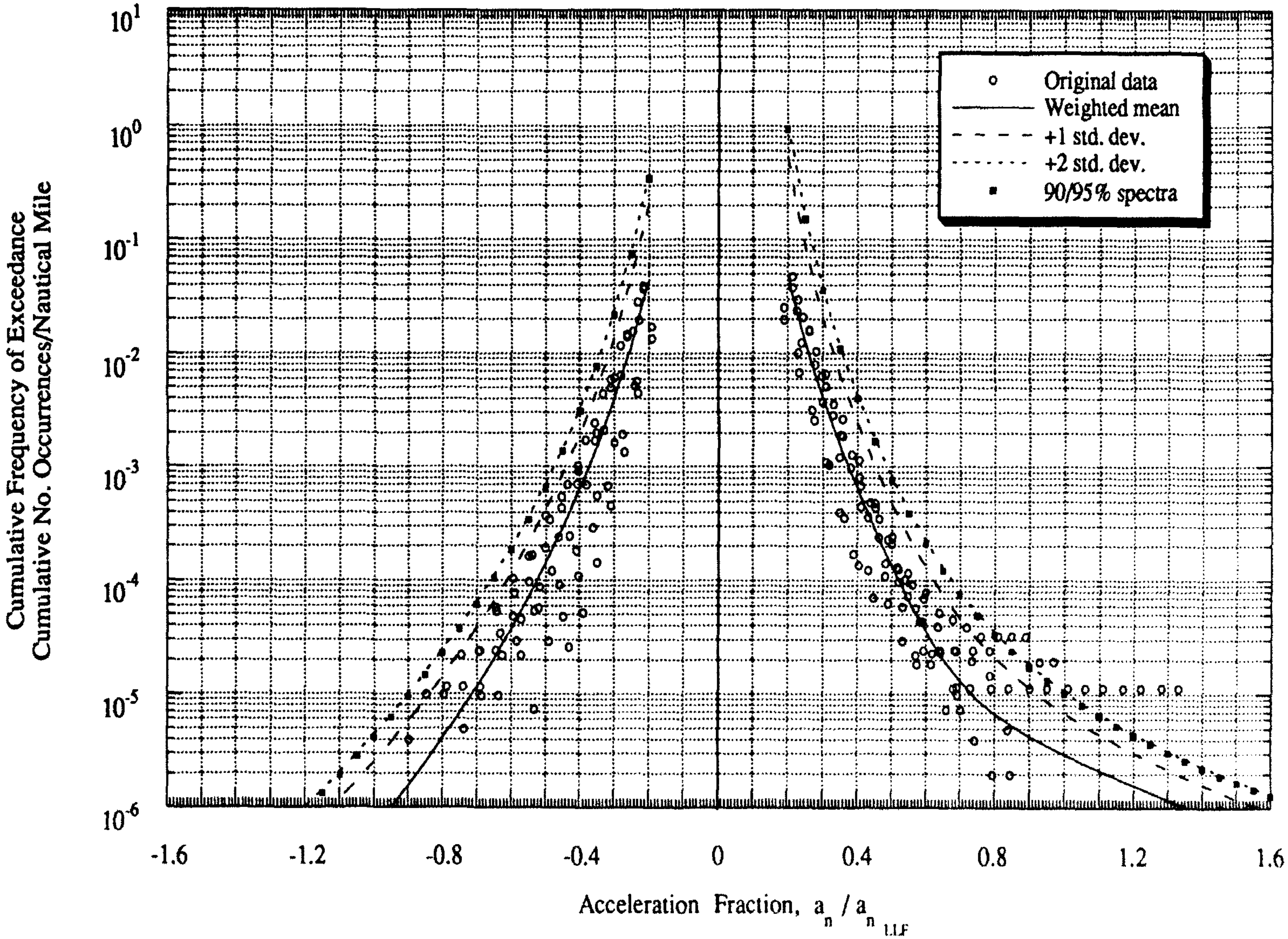


Figure D-12 Maneuver Load Spectra: Twin-Engine General Usage

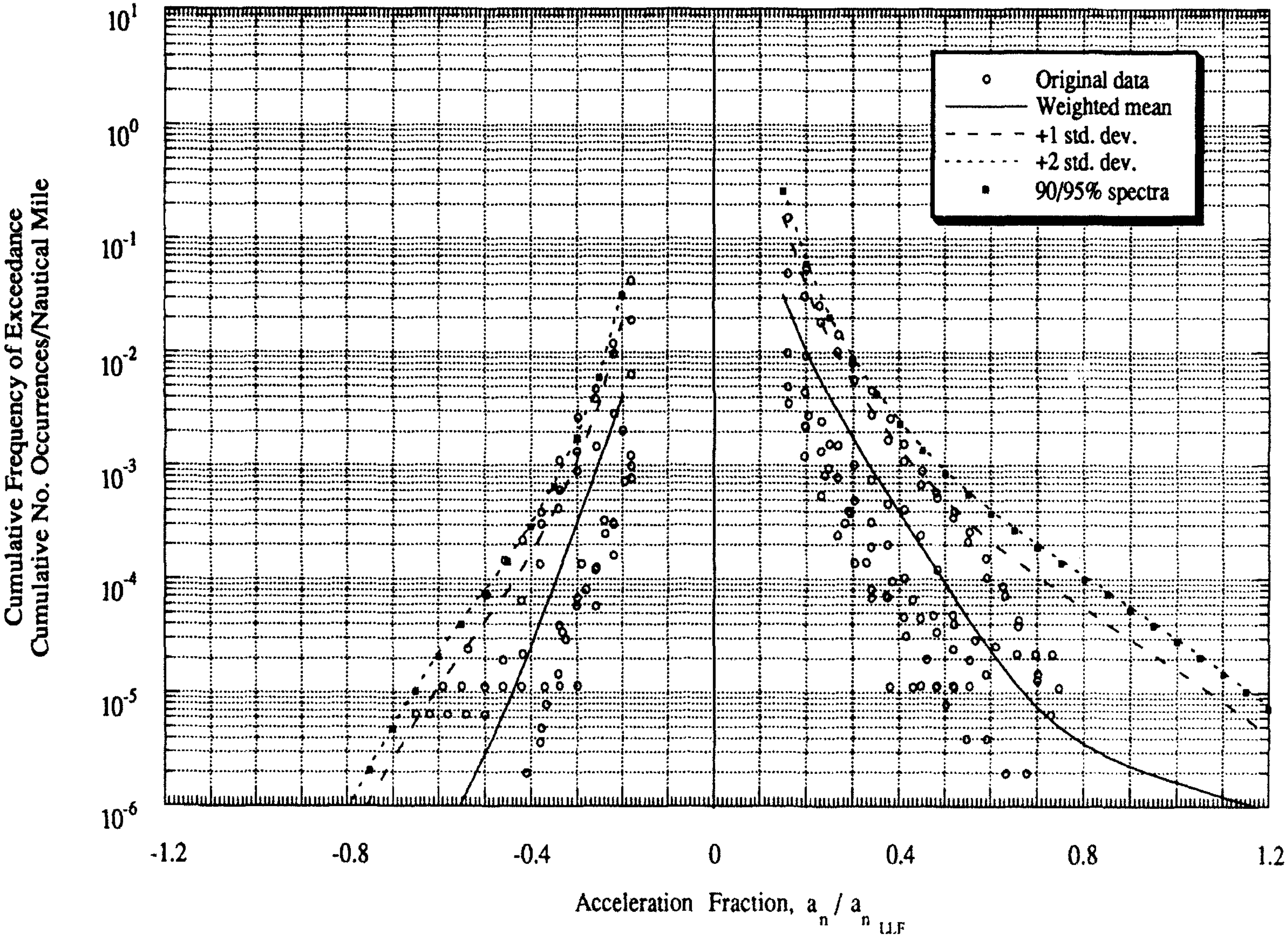


Figure D-13 Gust Load Spectra: Twin-Engine Special Usage

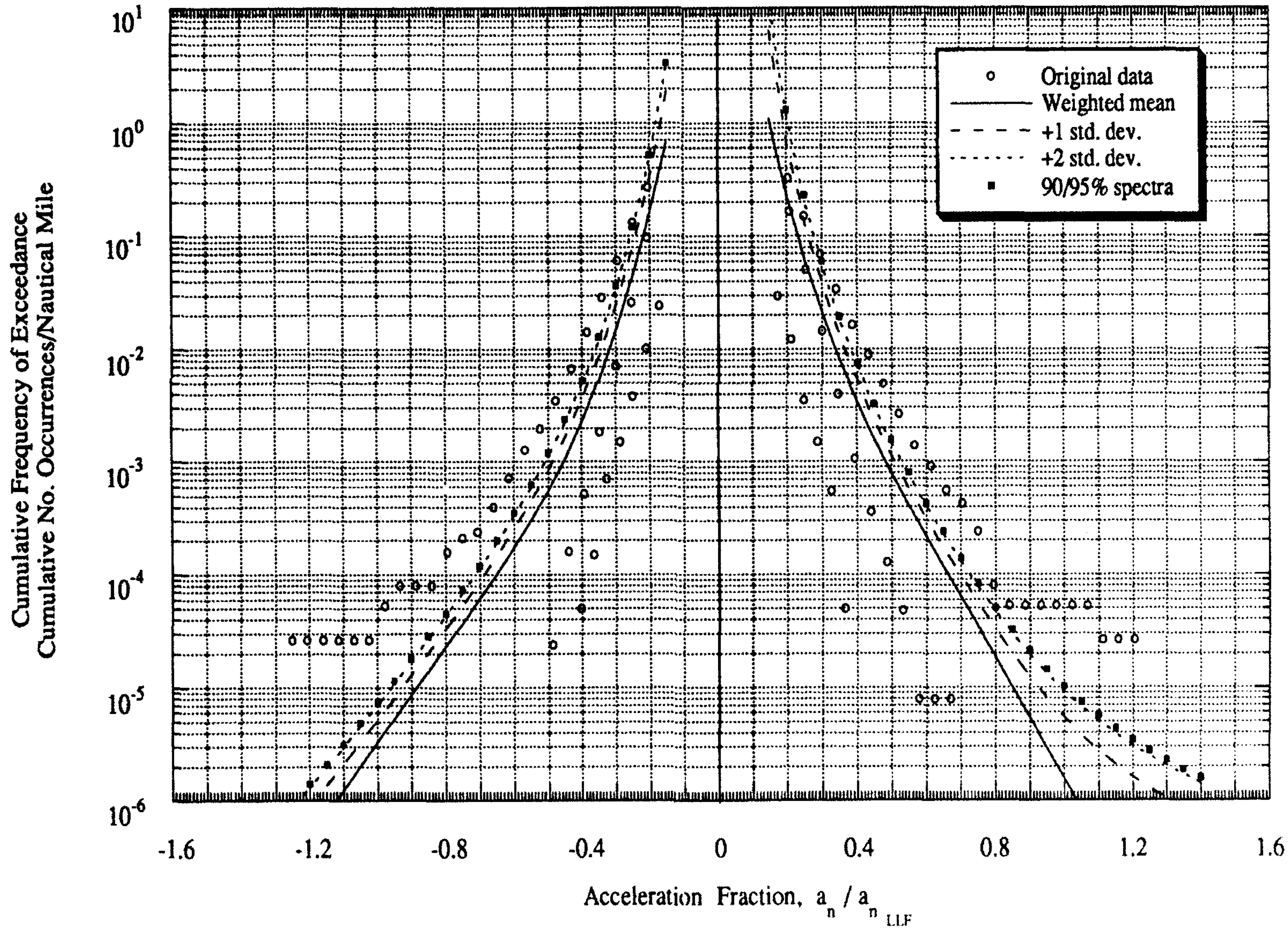


Figure D-14 Maneuver Load Spectra: Twin-Engine Special Usage

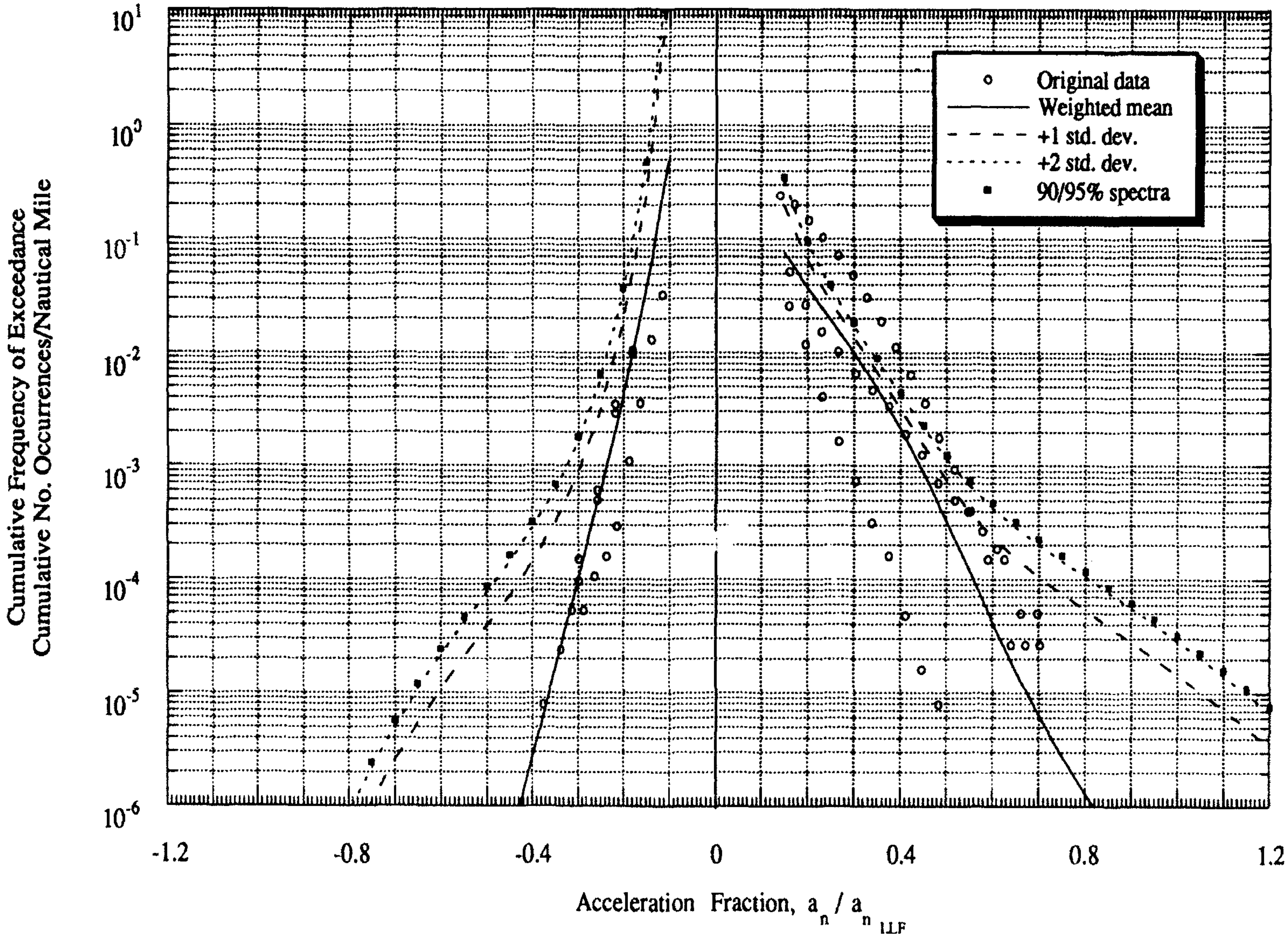


Figure D-15 Gust Load Spectra: Single and Twin-Engine Special Usage

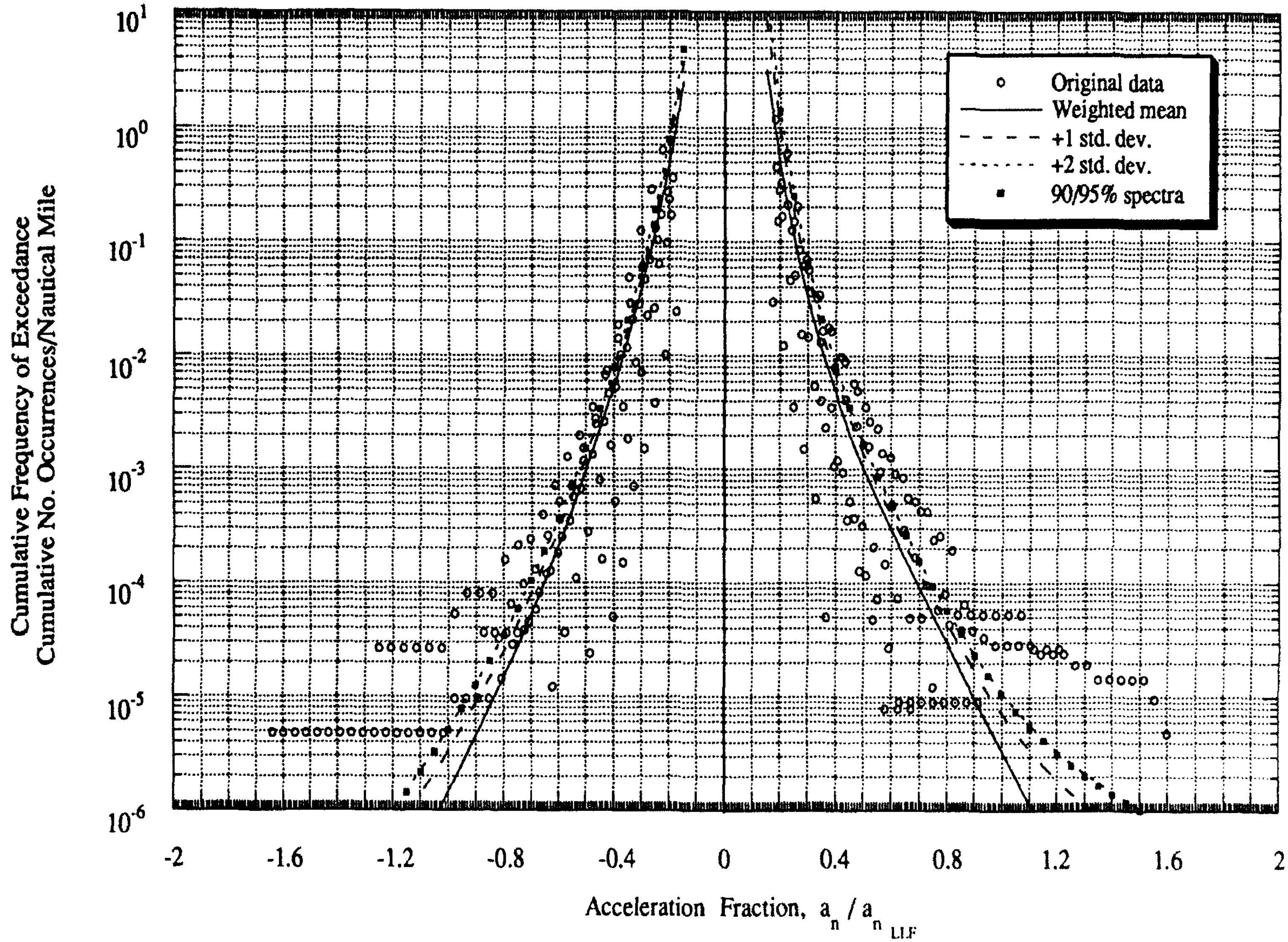


Figure D-16 Maneuver Load Spectra: Single and Twin-Engine Special Usage

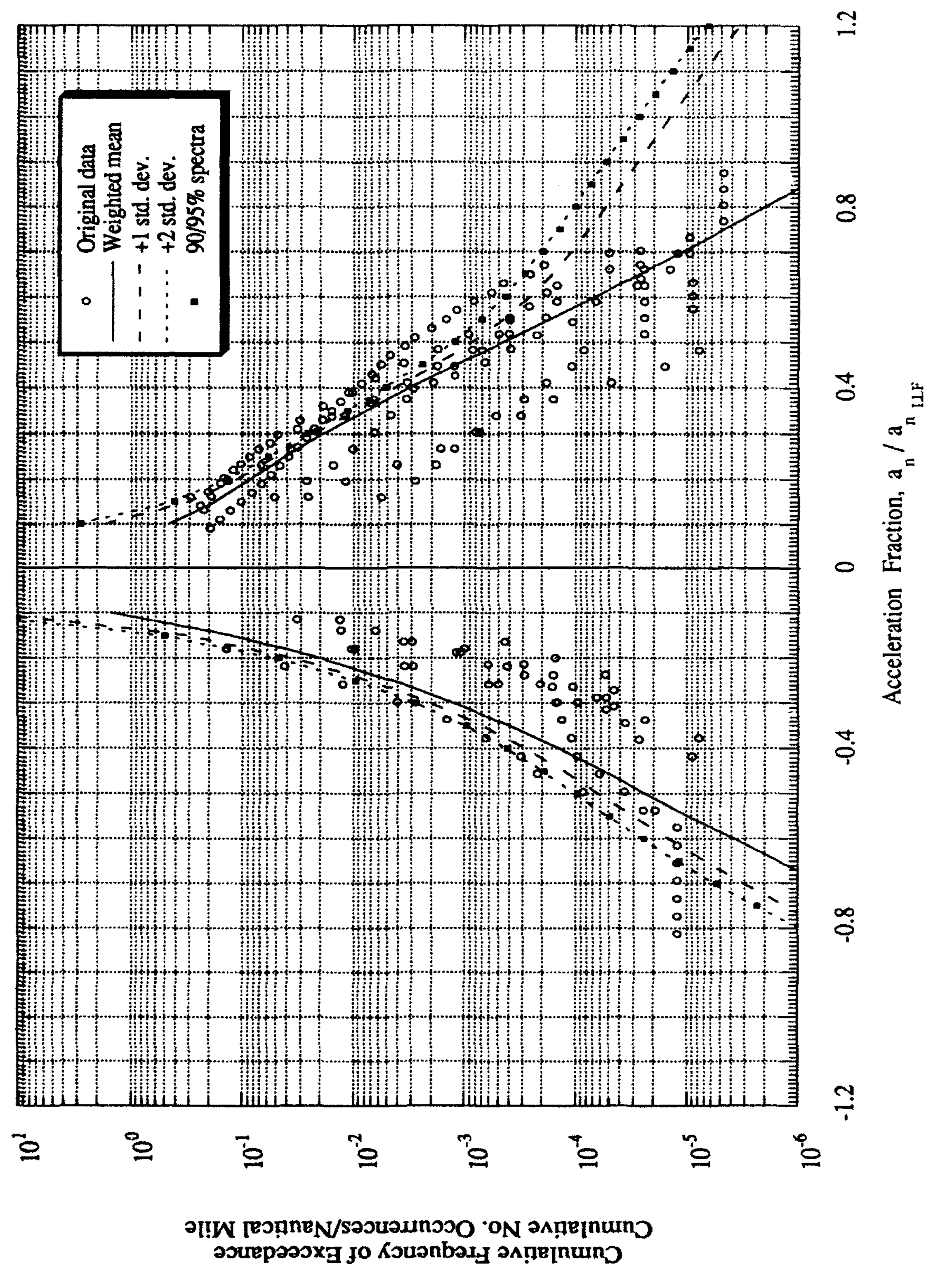


Figure D-17 Gust Load Spectra: Single and Twin-Engine Pressurized General Usage

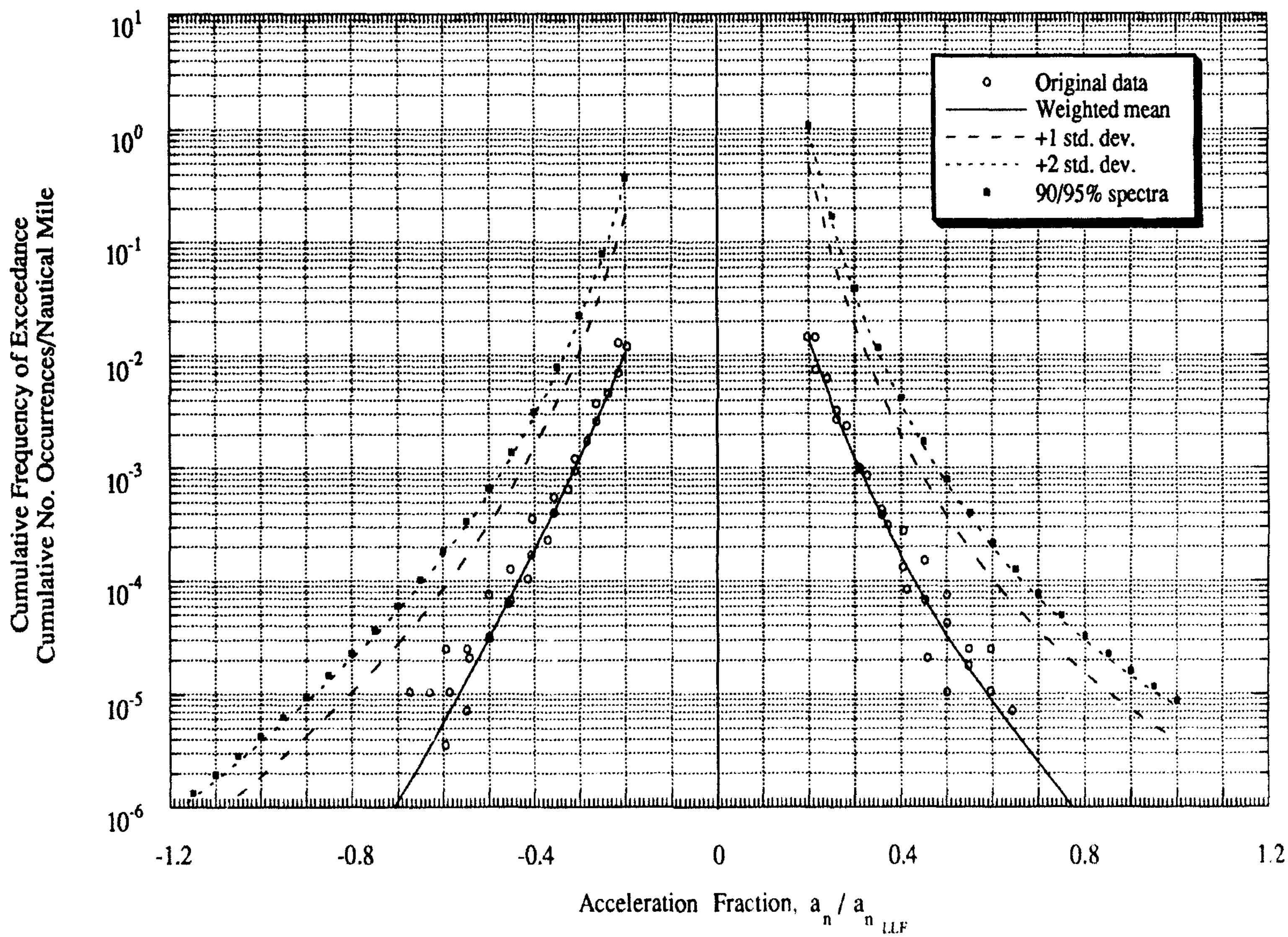
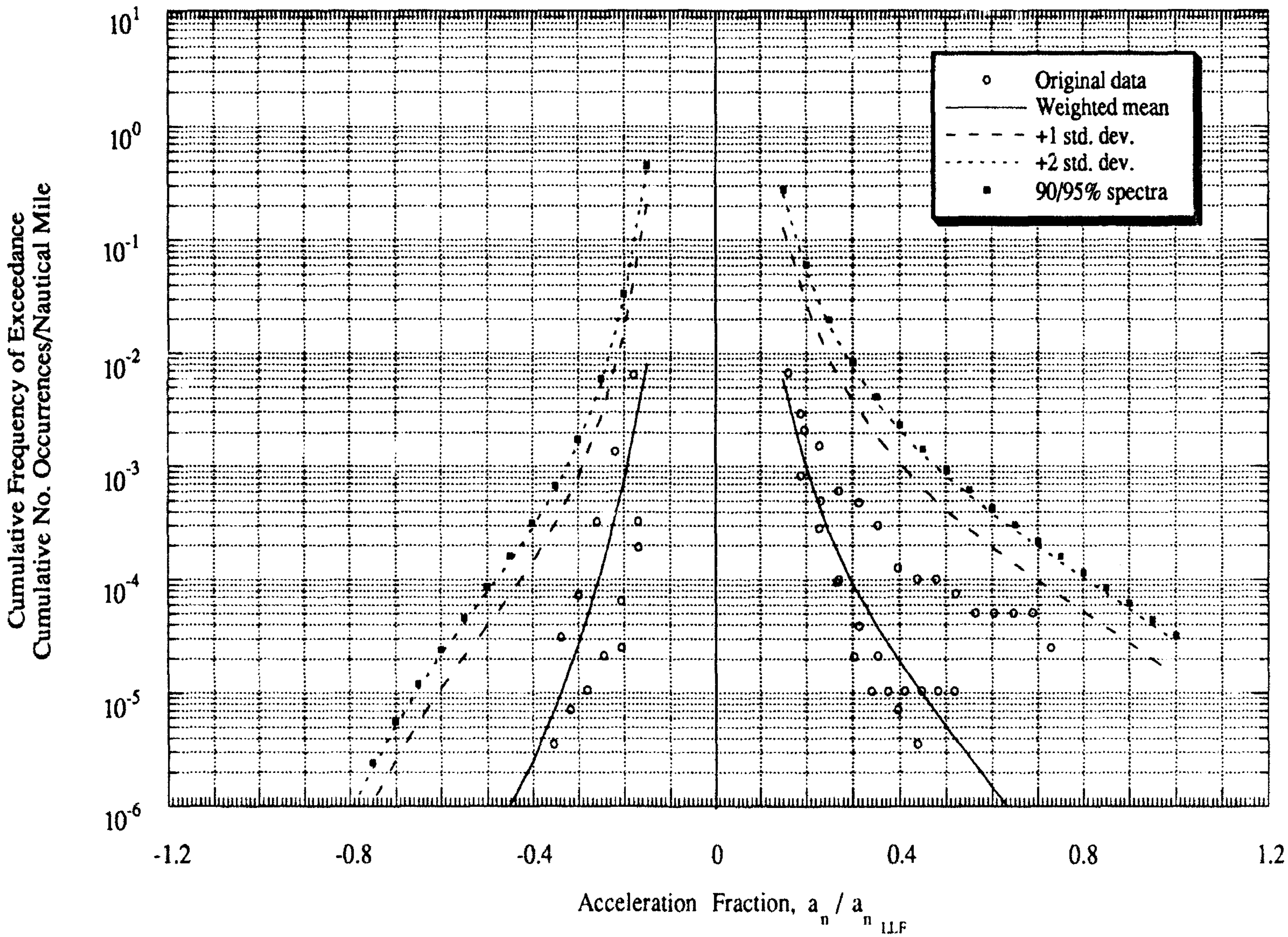


Figure D-18 Maneuver Load Spectra: Single and Twin-Engine Pressurized General Usage



Statistical Methods and Equations

This appendix contains a detailed explanation of the statistical analysis process. As mentioned in Section 2.5, the process involves four steps: (1) Curve fit the original data for each of the airplanes. (2) For each operational usage group, compute the weighted mean and weighted standard deviation; compute a pooled standard deviation by combining the group standard deviations; and compute the mean plus one, two and three standard deviation spectra. (3) Compute the 90% probability/95% confidence spectra. (4) Analyze the distribution of the original data. Steps 1 through 3 are covered in this appendix; step 4 is covered in Appendix E.

1. The Curve Fit Process

The objective of the curve fit process is to obtain for each airplane an equation for the cumulative frequency of exceedance (a y-value) as a function of acceleration fraction (an x-value). The first step is to determine the minimum and maximum values of the acceleration fraction (x_{min} and x_{max}) for the original data. This is done for each airplane. The original data for each airplane is then curve fitted using the general equation

$$\log y = a_0 + a_1 x + a_2 x^2 + a_3 x^3 + a_4 \log x \qquad \text{(EQ 1)}$$

where the coefficients a_0 through a_4 are determined using the method of least squares and $x = |x|$ for negative acceleration fractions. The best curve fit for most airplanes is a special case of the general equation (i.e., one or more of the coefficients are equal to zero, $a_i = 0$ for $i = 0 \ldots 4$). For each special case the curve fit and original data were plotted and inspected. This process was applied by trial and error until: (1) the curve fit clearly followed the basic trend of the original data, and (2) the deviation of the curve fit from the original data was minimal. The resulting curve fit equations for each airplane, including non-statistical airplanes, are given in Appendix C. Plotted and tabulated results obtained from the curve fit equations are also presented with the original airplane data.

As discussed in Section 2.4, for some cases extreme data points at the highest accelerations produce a constant cumulative frequency of exceedance for several values of acceleration fraction. This is seen, for example, in the data for airplane No. 17, page C-22. If more data were collected, this peculiarity would either disappear or occur at a lower frequency. Therefore, to obtain curve fits that were consistent with the trend for the bulk of the data, extreme data points that resulted in a constant cumulative frequency of exceedance were excluded from the least squares curve fit analysis.

In performing any statistical analysis it is always difficult to precisely extrapolate beyond the limits of the original data. A direct application of the curve fit equation, beyond the limits (x_{min} and x_{max}) of the original airplane data, was found to be unsatisfactory due to the tendency of nonlinear functions (EQ 1) to exhibit minimums. For many cases the predicted cumulative frequency of exceedance was excessively high and clearly did not follow the trend of the data. To alleviate this problem, a linear extrapolation was used for $x > x_{max}$. Thus, two curve fits are used for all airplanes included in the statistical analysis: a curve fit for the original data and a curve fit for extrapolation. The extrapolation curve fit equations are also given in Appendix C.

2. Mean and Standard Deviation

For each operational usage group the weighted mean and weighted standard deviation are calculated as a function of acceleration fraction by passing a vertical cut through each of the curve fits. This produces a cumulative frequency of exceedance (y_i) for each airplane in the group. The weighted statistics are then computed as

$$y_w = \frac{1}{n}\sum \frac{nt_i}{T} y_i \qquad S_w = \sqrt{\frac{\sum \frac{nt_i}{T}(y_i - y_w)^2}{n-1}} \qquad \text{(EQ 2)}$$

where y_w is the weighted mean, S_w is the weighted standard deviation, n is the number of airplanes in the group, t_i is the flight hours for airplane i, and T is the total flight hours of the group. Weighted statistics were used to account for the large variation of flight data hours collected on the individual airplanes in each group.

After the weighted standard deviation has been computed for each operational usage group, an improved estimate of the standard deviation (for groups with small sample sizes) can be computed using a pooled variance approach:

$$S_p^2 = \frac{\sum (n_i - 1) S_{wi}^2}{\sum (n_i - 1)} \qquad \text{(EQ 3)}$$

where S_{wi} is the weighted standard deviation for group i, n_i is the number of airplanes in group i, and S_p is the pooled standard deviation. As mentioned in Section 2.5, using a pooled standard deviation minimizes the large uncertainties (and scatter) associated with small sample sizes (e.g., groups 5 and 6 - three airplanes, group 2 - four airplanes) and results in more consistent estimates for the 90/95% usage spectra. The pooled standard deviation approach was used for all spectra except the group 3 (Aerial Application) maneuver spectra. This group was excluded since the Aerial Application maneuver loads are substantially higher than maneuver loads for the other groups. The rationale for pooling the group variances (with the exclusion of group 3) is examined in Appendix E.

3. Confidence Spectra Estimates

In accordance with the Part 23 Airplane Fatigue Working Group's recommendation (see Section 1.5) the confidence spectra for each statistical group were determined based on 90% probability with a 95% confidence level. Mathematically the 90/95% spectra can be expressed as

$$y_{90/95} = \mu + \delta \qquad \text{(EQ 4)}$$

where μ is the estimate of the population mean with 95% confidence and δ corresponds to the scatter for 90% of the population. For all groups (except group 3, maneuver) the population

standard deviation was assumed to be equal to the pooled standard deviation S_p. Based on this assumption, for a population with a known standard deviation ($\sigma = S_p$) the 95% confidence level for the population mean μ is

$$\mu = \bar{y}_w + 1.645 \frac{S_p}{\sqrt{n}} \tag{EQ 5}$$

where $\bar{y}_w$ is the group weighted mean and n is the number of airplanes in the group. This equation is based on a normal distribution with 1.645 being the z-value corresponding to the 95% cumulative probability level of the normal distribution. For the Aerial Application maneuver spectra, the population standard deviation is assumed to be unknown. The 95% confidence level for μ with σ unknown is

$$\mu = \bar{y}_w + t_{\alpha,n-1} \frac{S_w}{\sqrt{n}} \tag{EQ 6}$$

where $t_{\alpha,n-1}$ is the t-value (for the Student's t distribution) corresponding to a confidence interval $1 - \alpha$. Thus, for a 95% confidence interval the t-value is $t_{0.05,n-1}$. Corresponding equations for the scatter factor δ are given by

$$\begin{aligned} \delta &= 1.282\sigma \\ \text{where} \quad \sigma &= S_p \qquad \text{for } \sigma \text{ known} \\ \sigma &= \sqrt{\frac{n-1}{\chi^2_{0.95,n-1}}}\, S_w \qquad \text{for } \sigma \text{ unknown} \end{aligned} \tag{EQ 7}$$

where $\chi^2_{0.95,n-1}$ is the Chi-square value for a 95% confidence interval and 1.282 is the 90% cumulative probability level of the normal distribution. Equations (5) - (7) along with t-values and χ^2-values can be found in any standard statistical text.

APPENDIX E:

ANALYSIS OF THE DISTRIBUTION OF THE DATA

Appendix E Table of Contents

Data Analysis

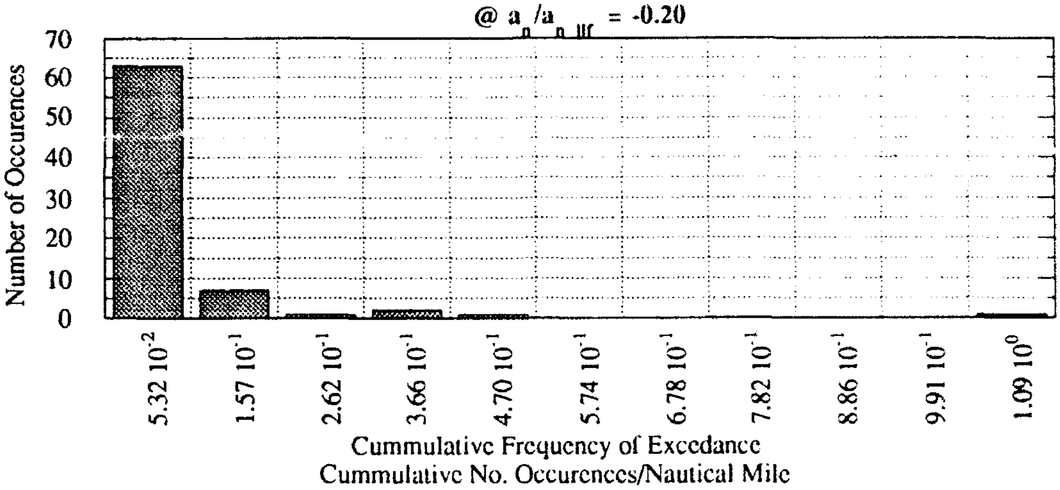
Histograms	Normal Page	Logarithmic Page
Pooled:		
Negative Gust	E-3	E-4
Positive Gust	E-5	E-6
Negative Maneuver	E-7	E-8
Positive Maneuver	E-9	E-10
Pooled without Group 3:		
Negative Maneuver		E-11
Positive Maneuver		E-12

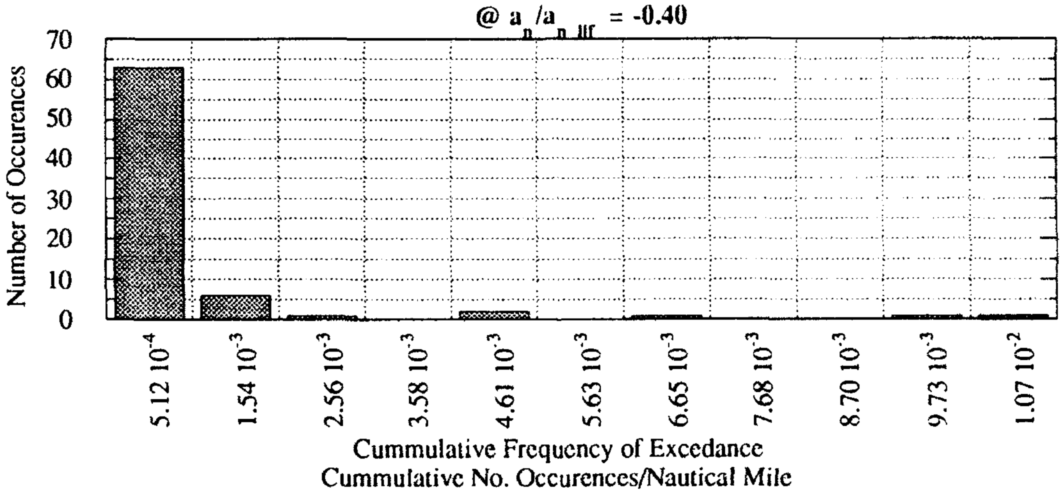
Group Standard Deviations E-13

Bartlett's Test E-16

Discussion E-17

Figure E-1 Normal Histogram: Negative Gust, All Statistical Aircraft





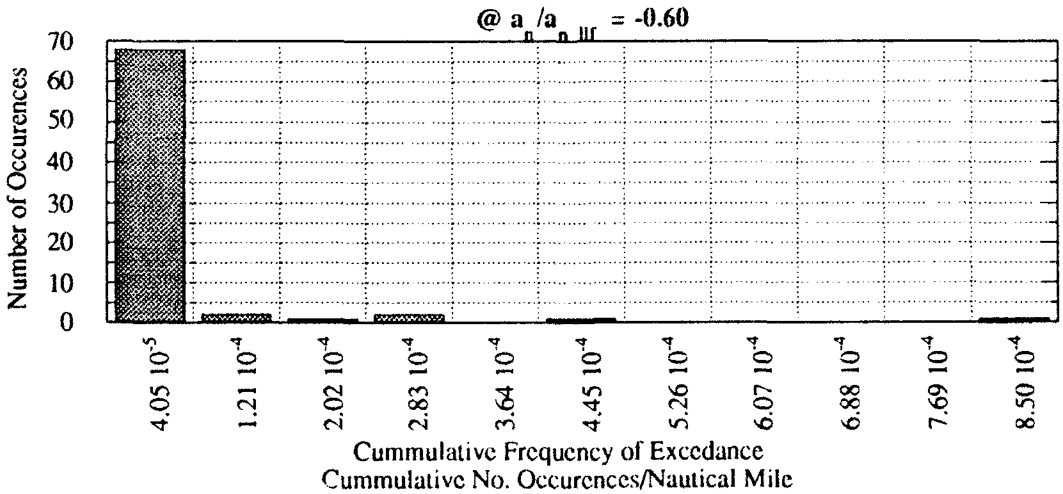
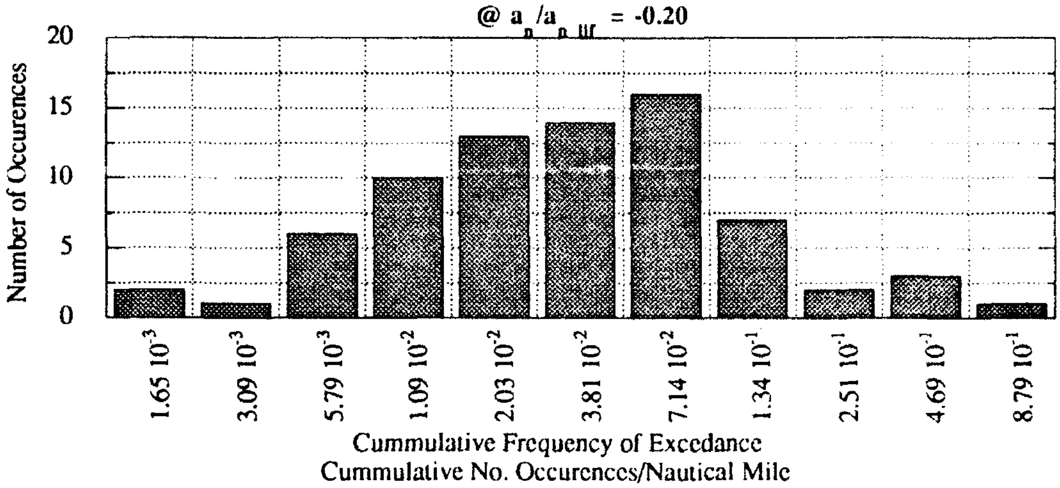
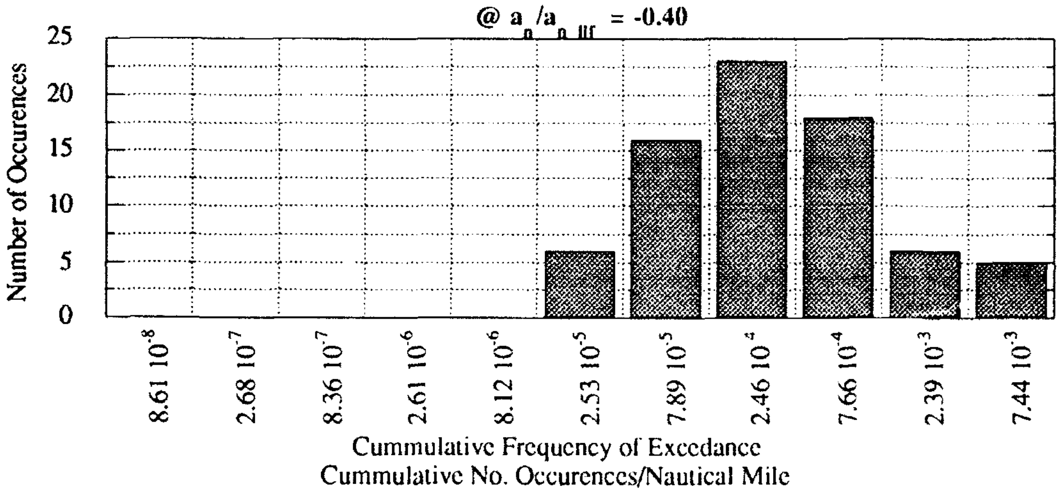


Figure E-2 Logarithmic Histogram: Negative Gust, All Statistical Aircraft





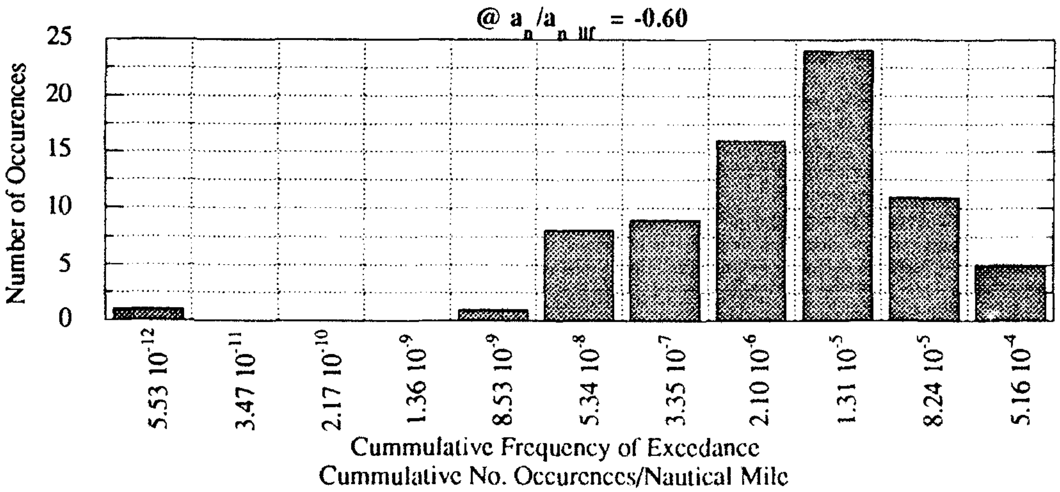
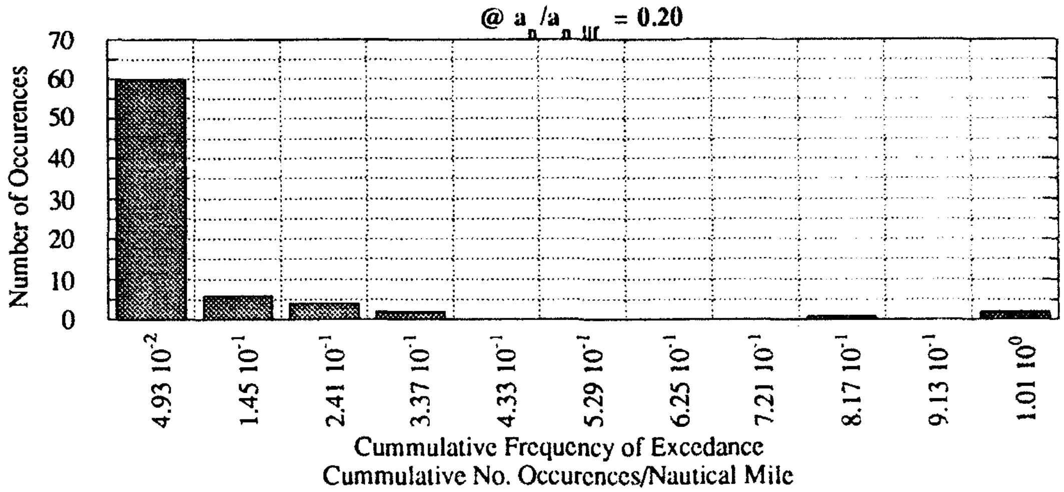
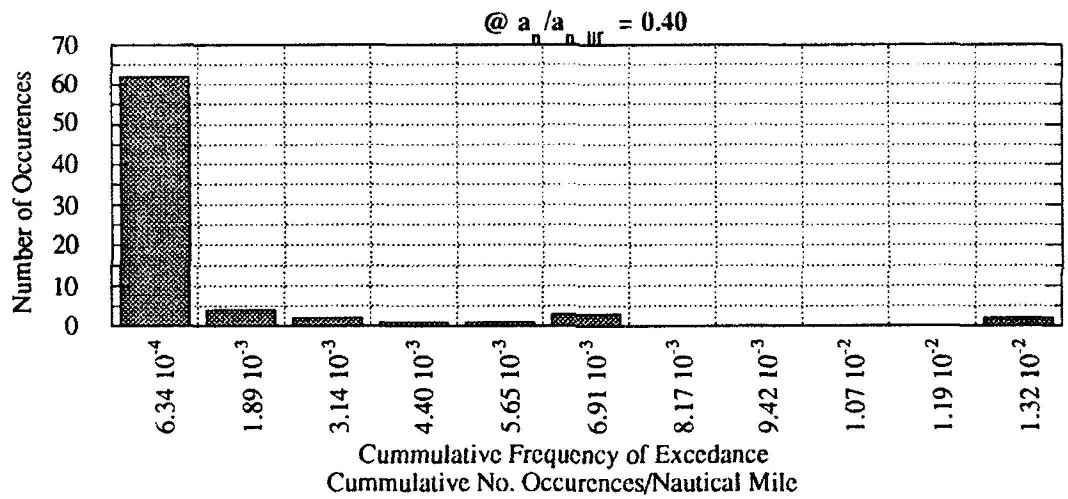


Figure E-3 Normal Histogram: Positive Gust, All Statistical Aircraft





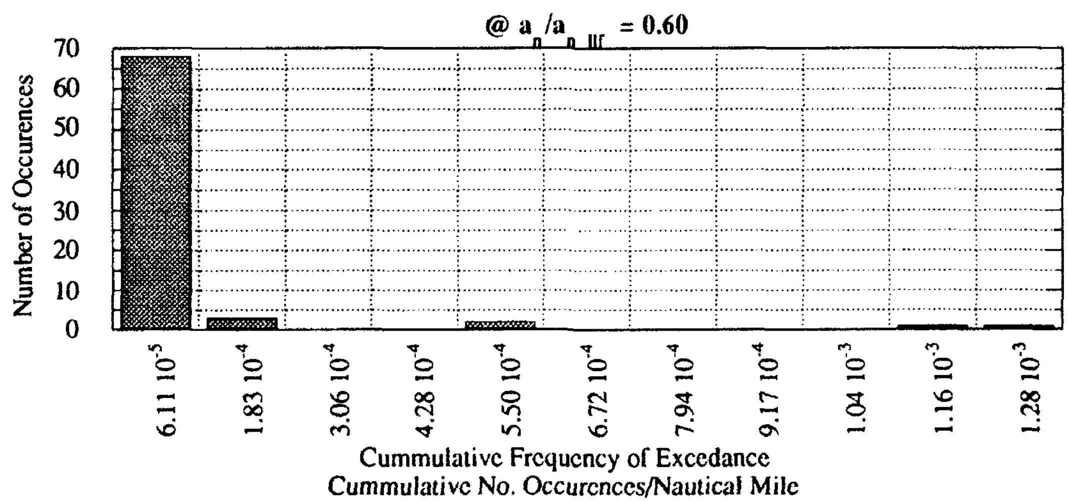
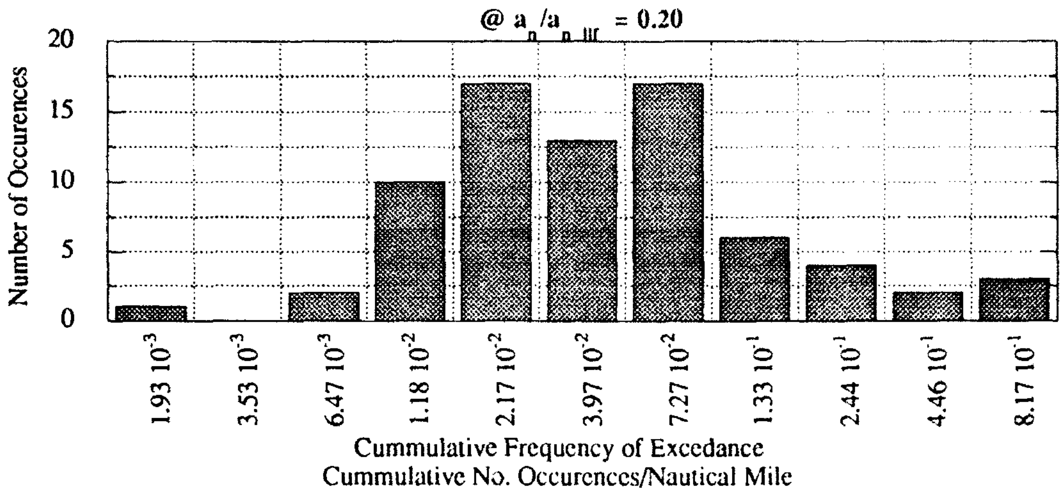
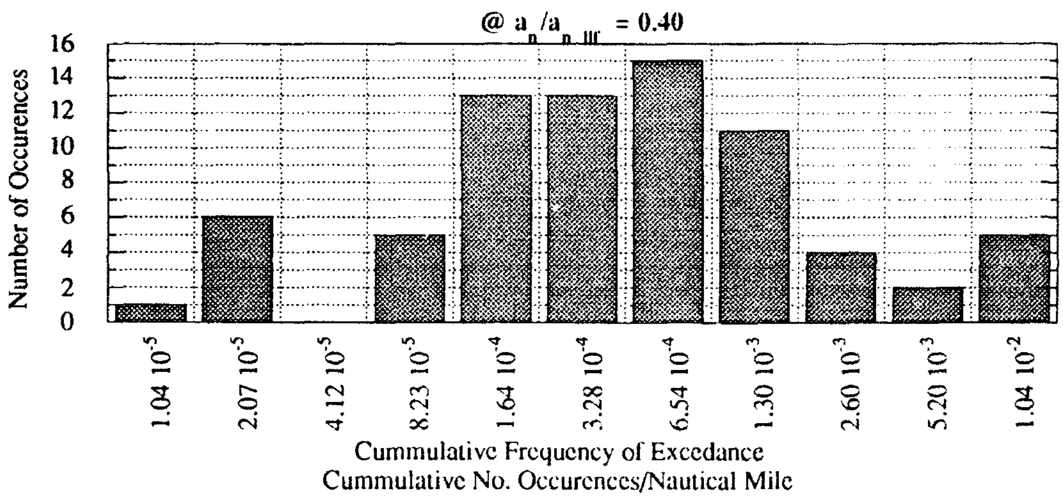


Figure E-4 Logarithmic Histogram: Positive Gust, All Statistical Aircraft





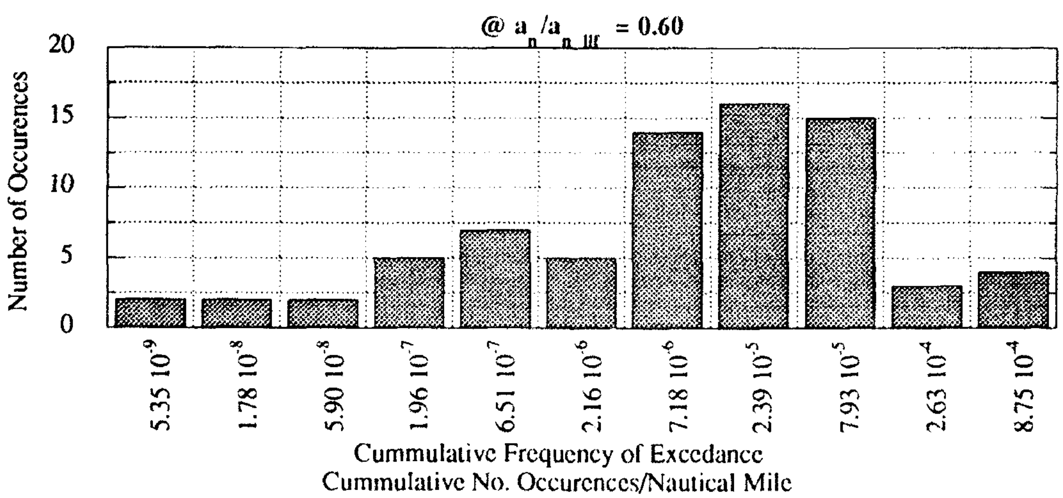
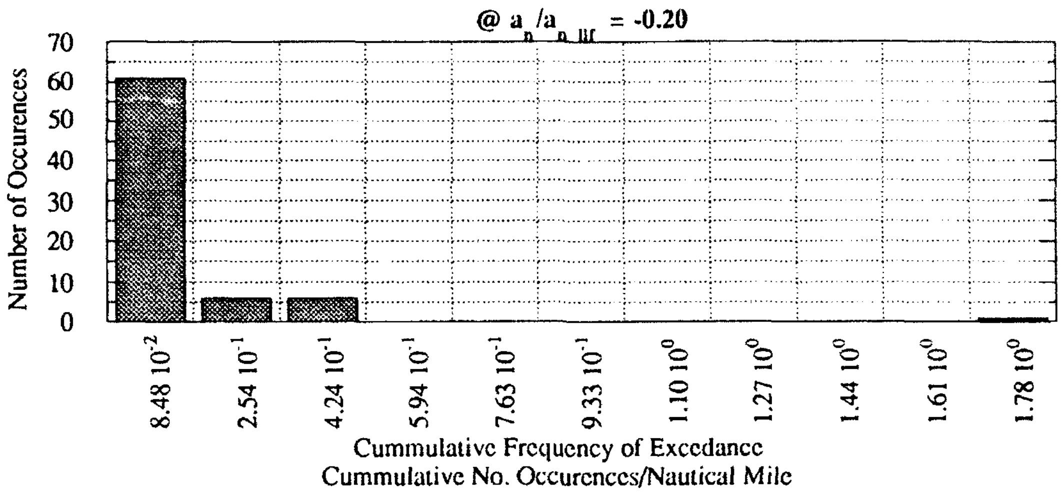
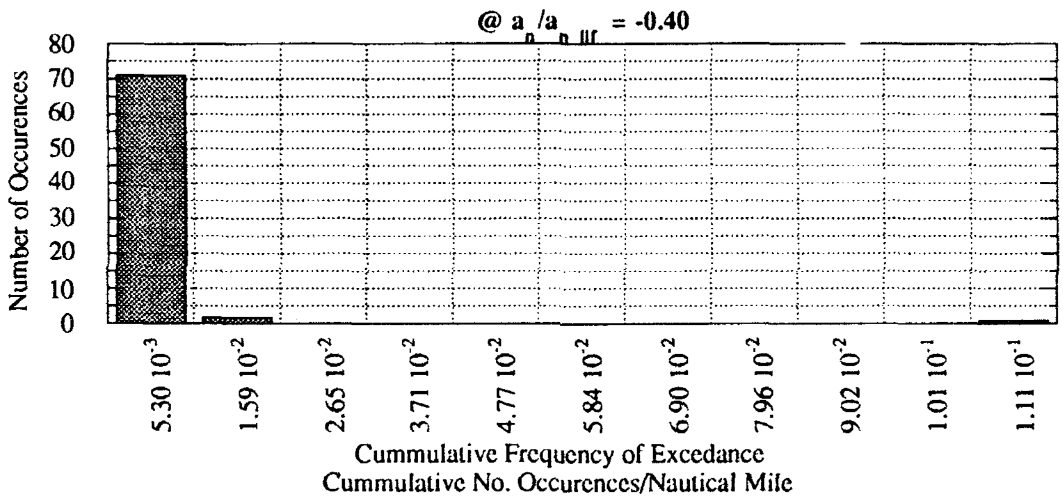


Figure E-5 Normal Histogram: Negative Maneuver, All Statistical Aircraft





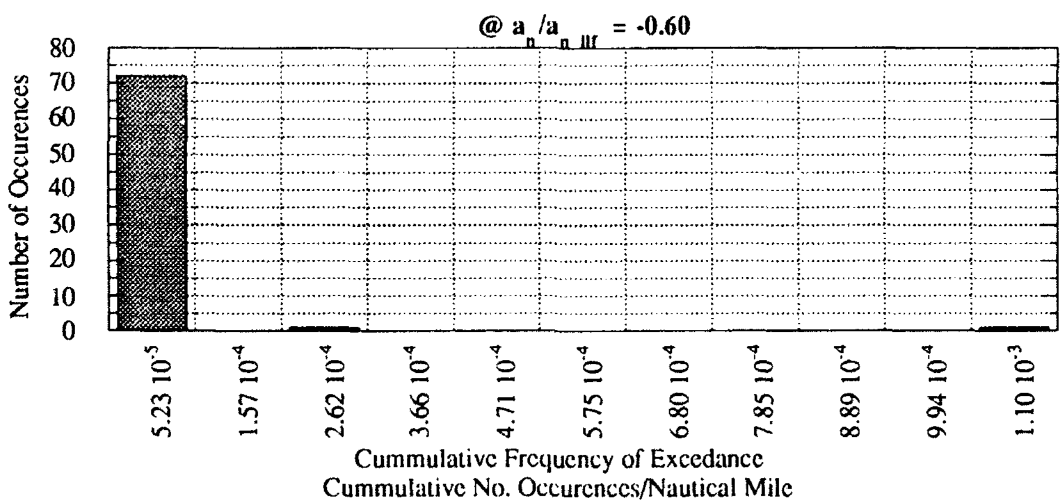
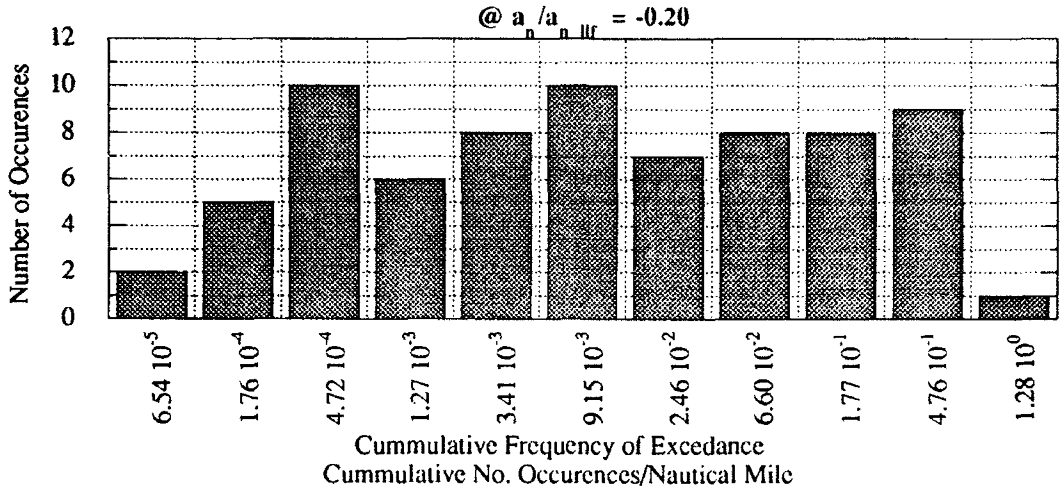
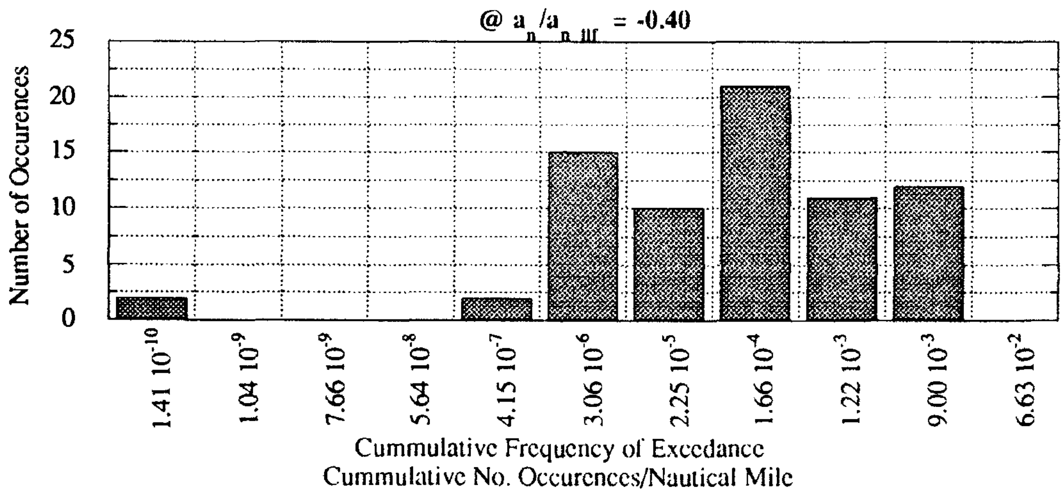


Figure E-6 Logarithmic Histogram: Negative Maneuver, All Statistical Aircraft





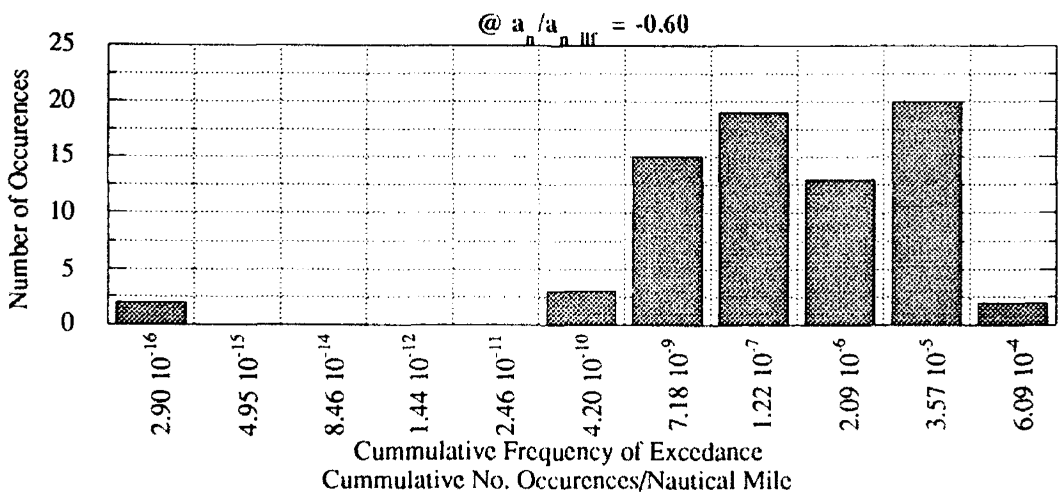
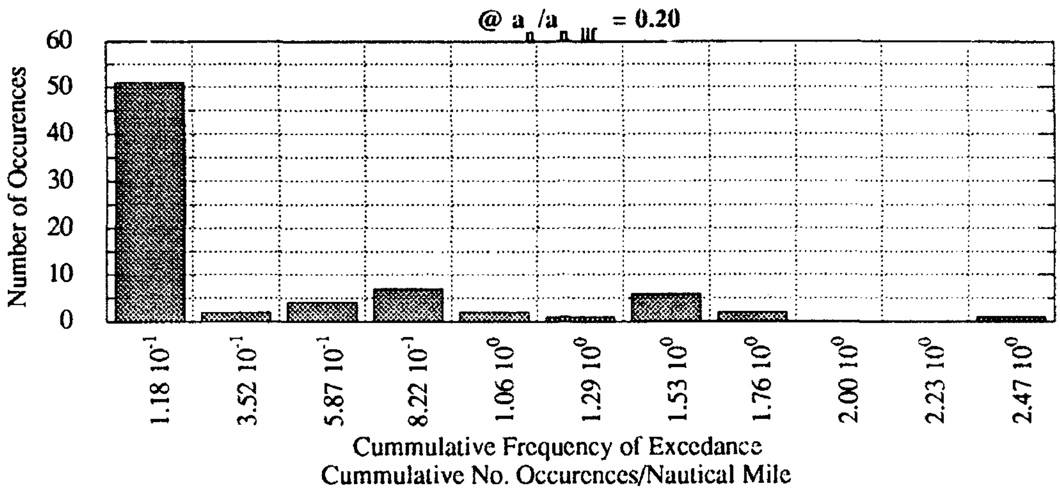
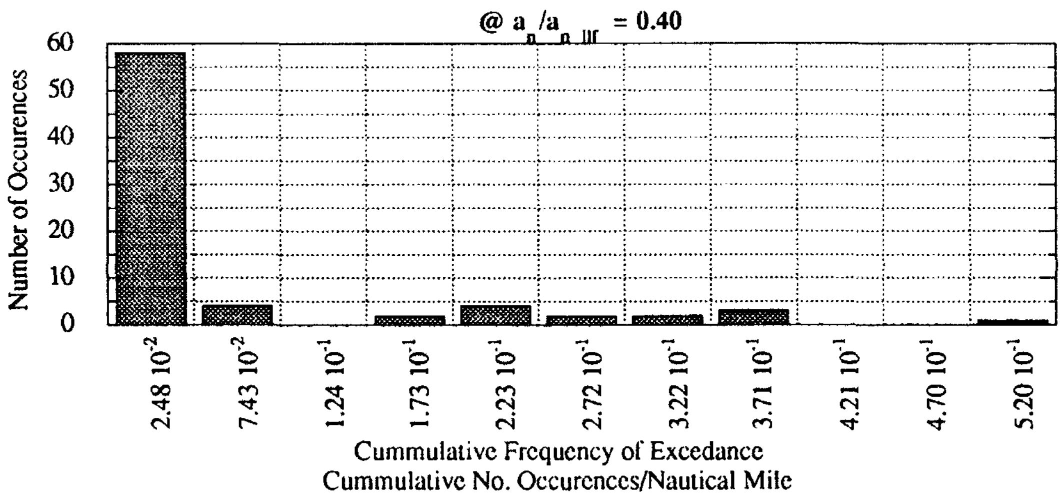


Figure E-7 Normal Histogram: Positive Maneuver, All Statistical Aircraft





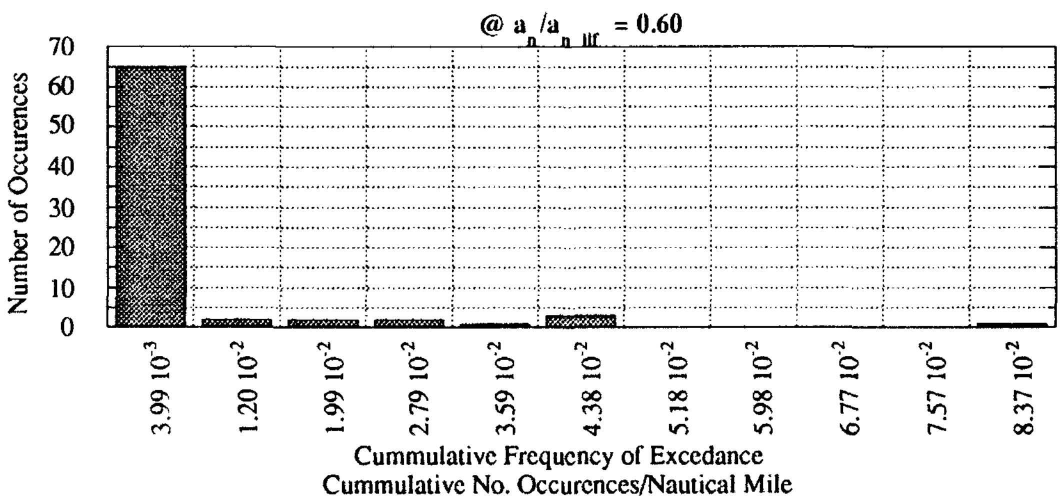
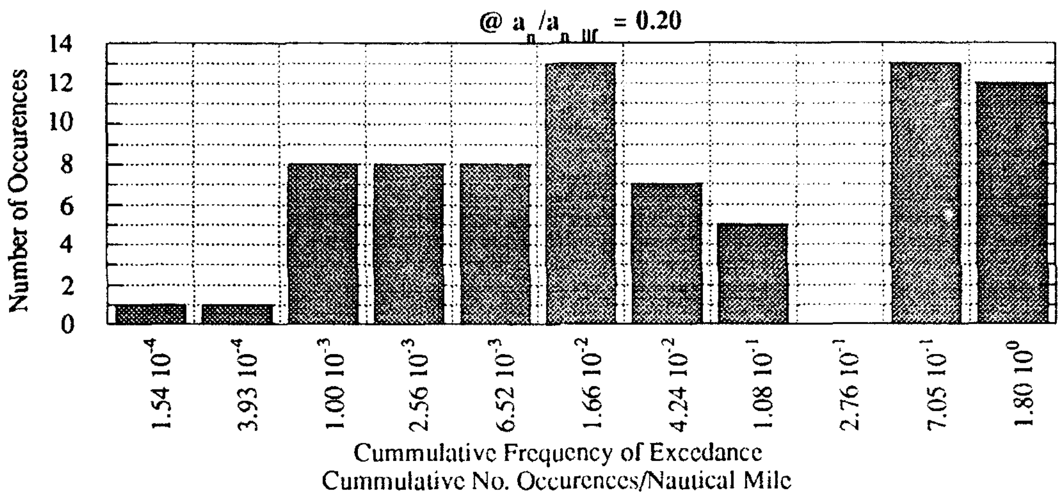
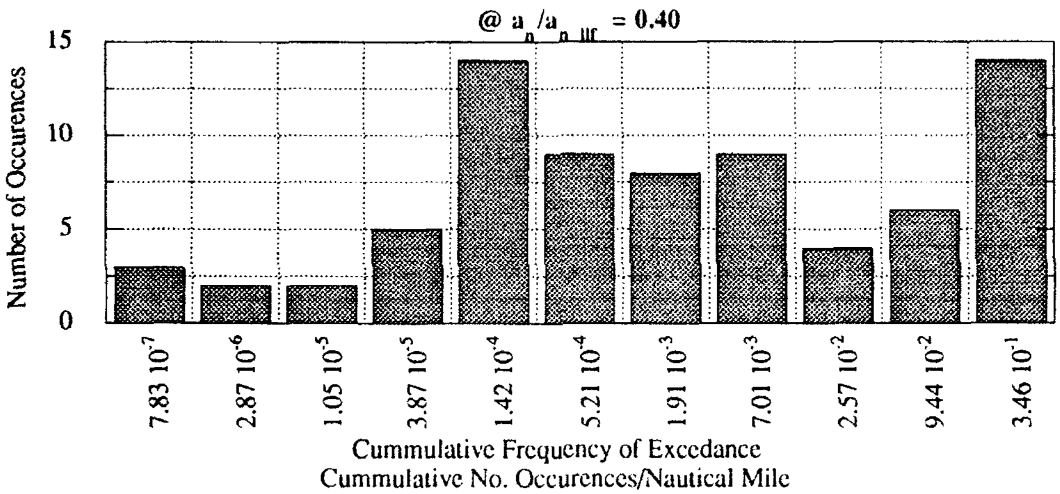


Figure E-8 Logarithmic Histogram: Positive Maneuver, All Statistical Aircraft





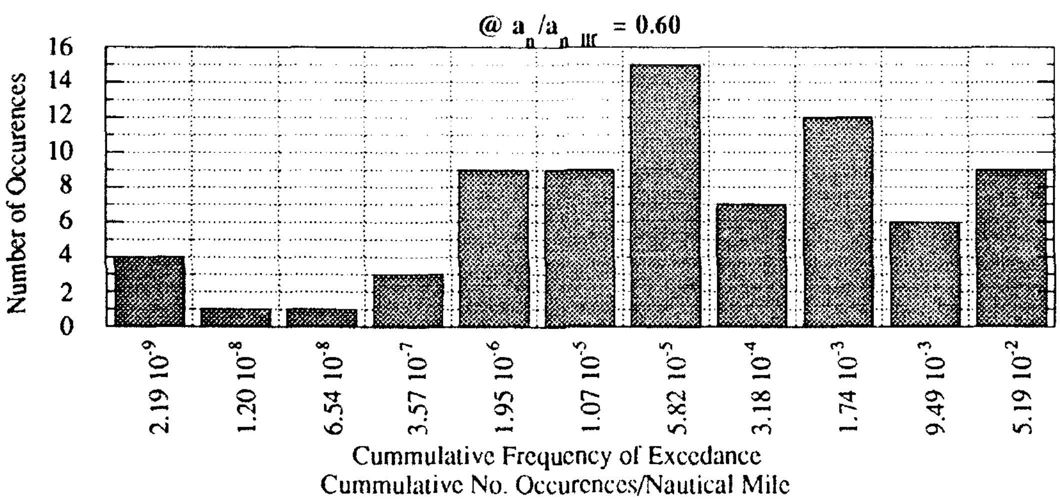
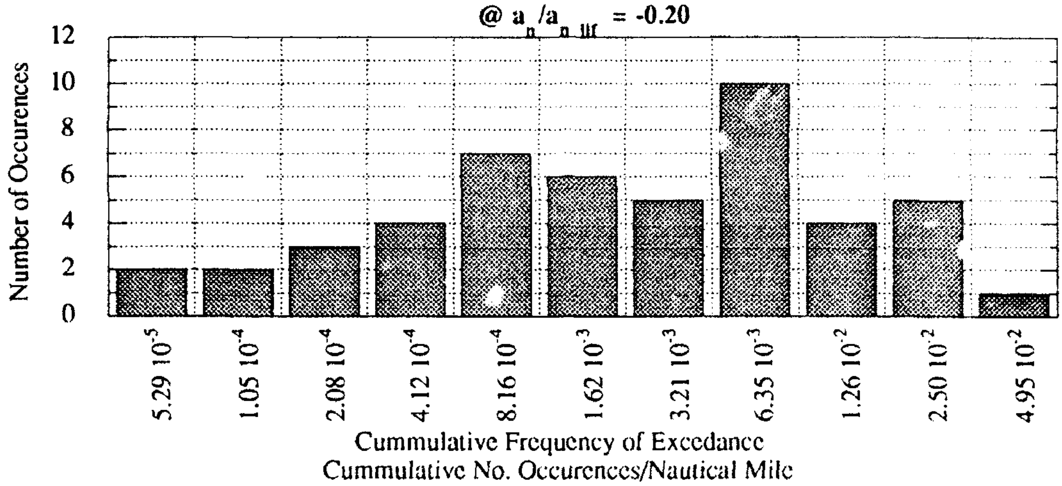
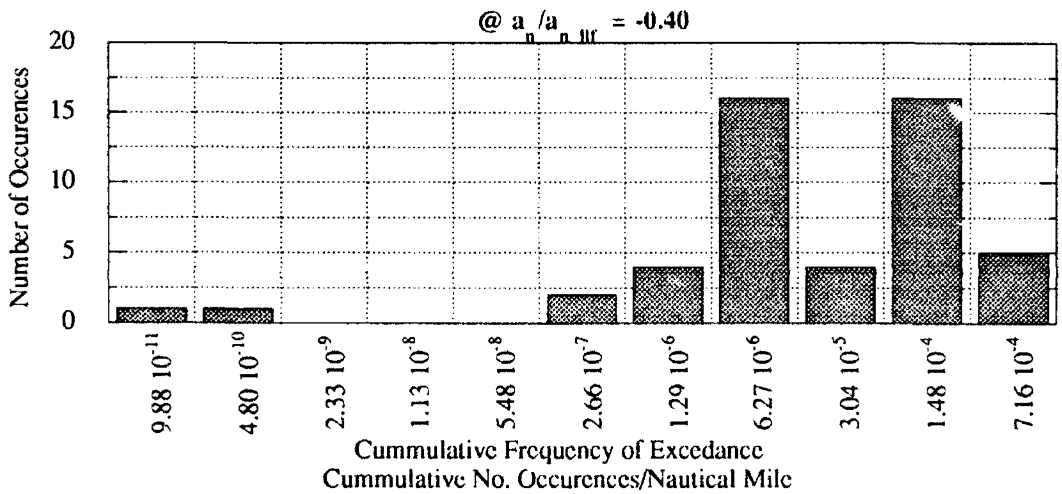


Figure E-9 Logarithmic Histogram: Negative Maneuver, All Statistical Aircraft Except Group 3





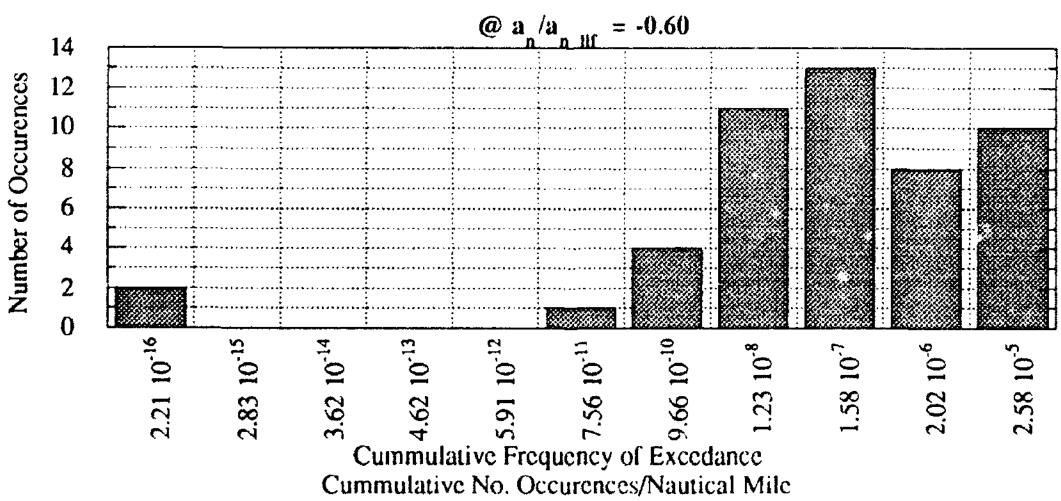
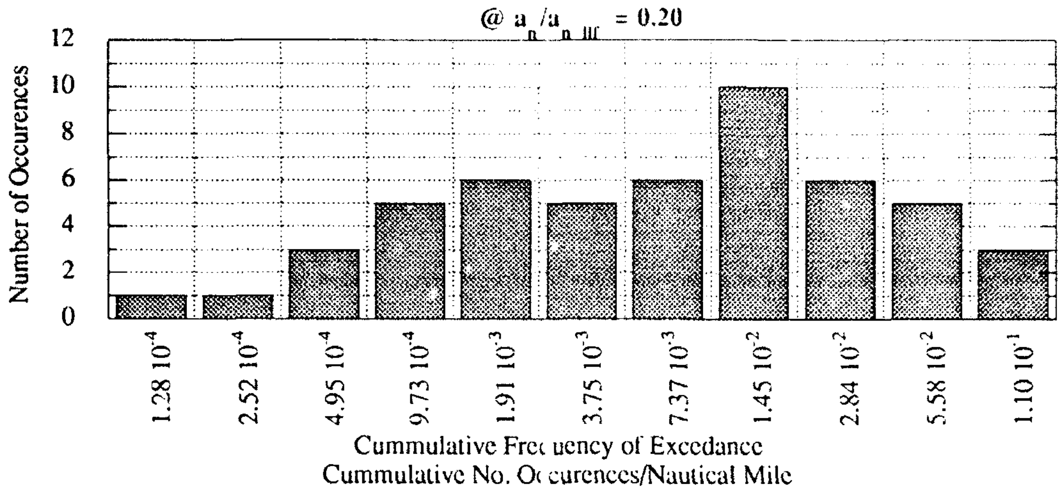
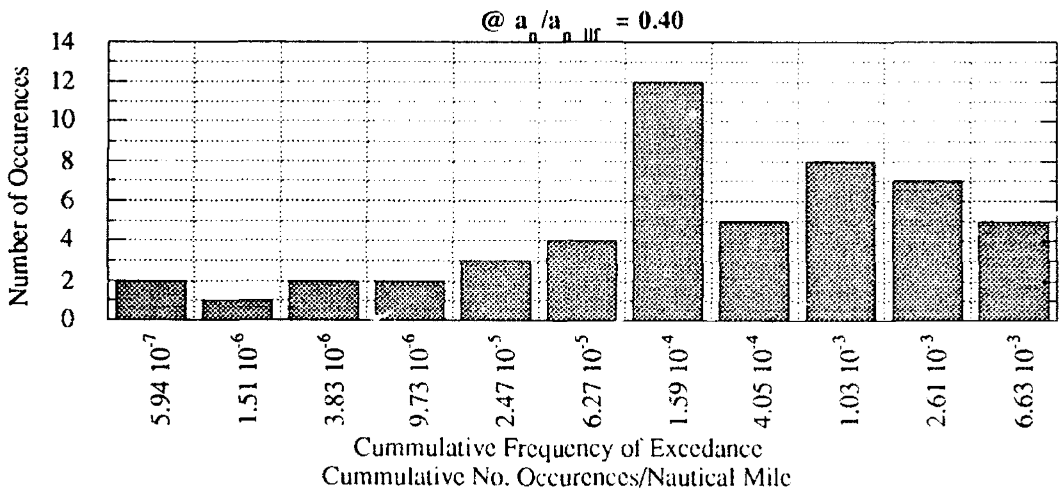


Figure E-10 Logarithmic Histogram: Positive Maneuver, All Statistical Aircraft Except Group 3





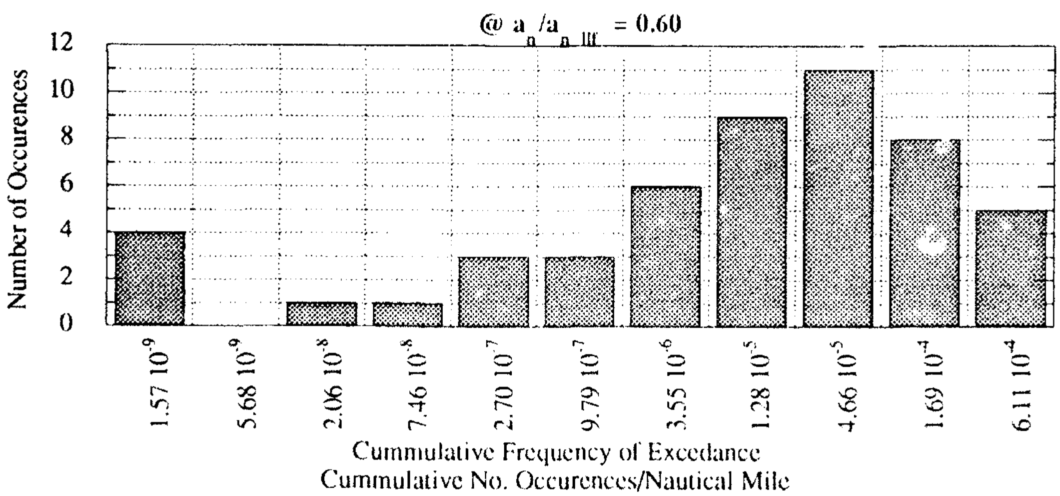


Figure E-11 Maneuver: Weighted Standard Deviation for Each Group and Pooled

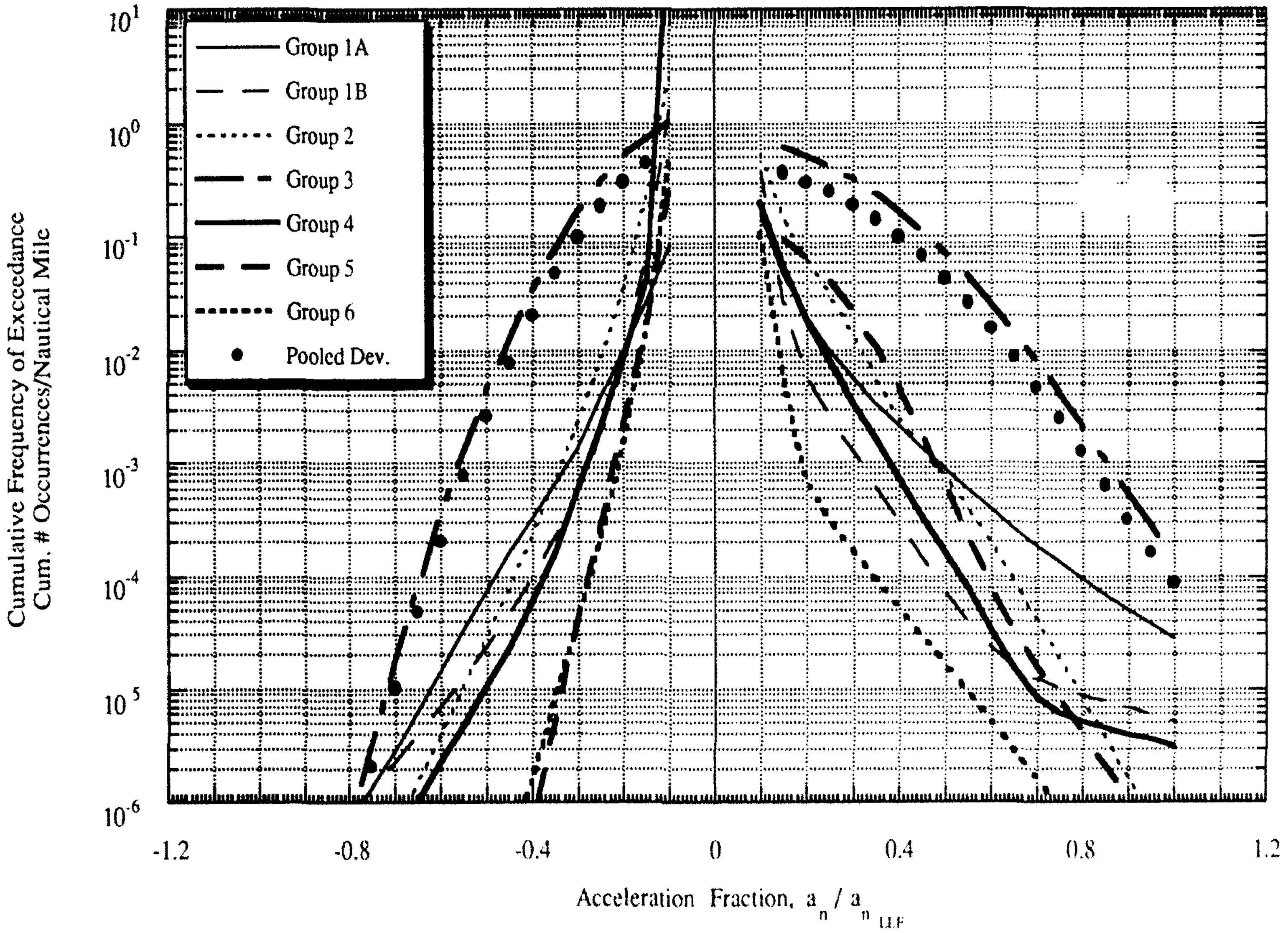


Figure E-12 Maneuver:Weighted Standard Deviation for Each Group and Pooled Without Group 3

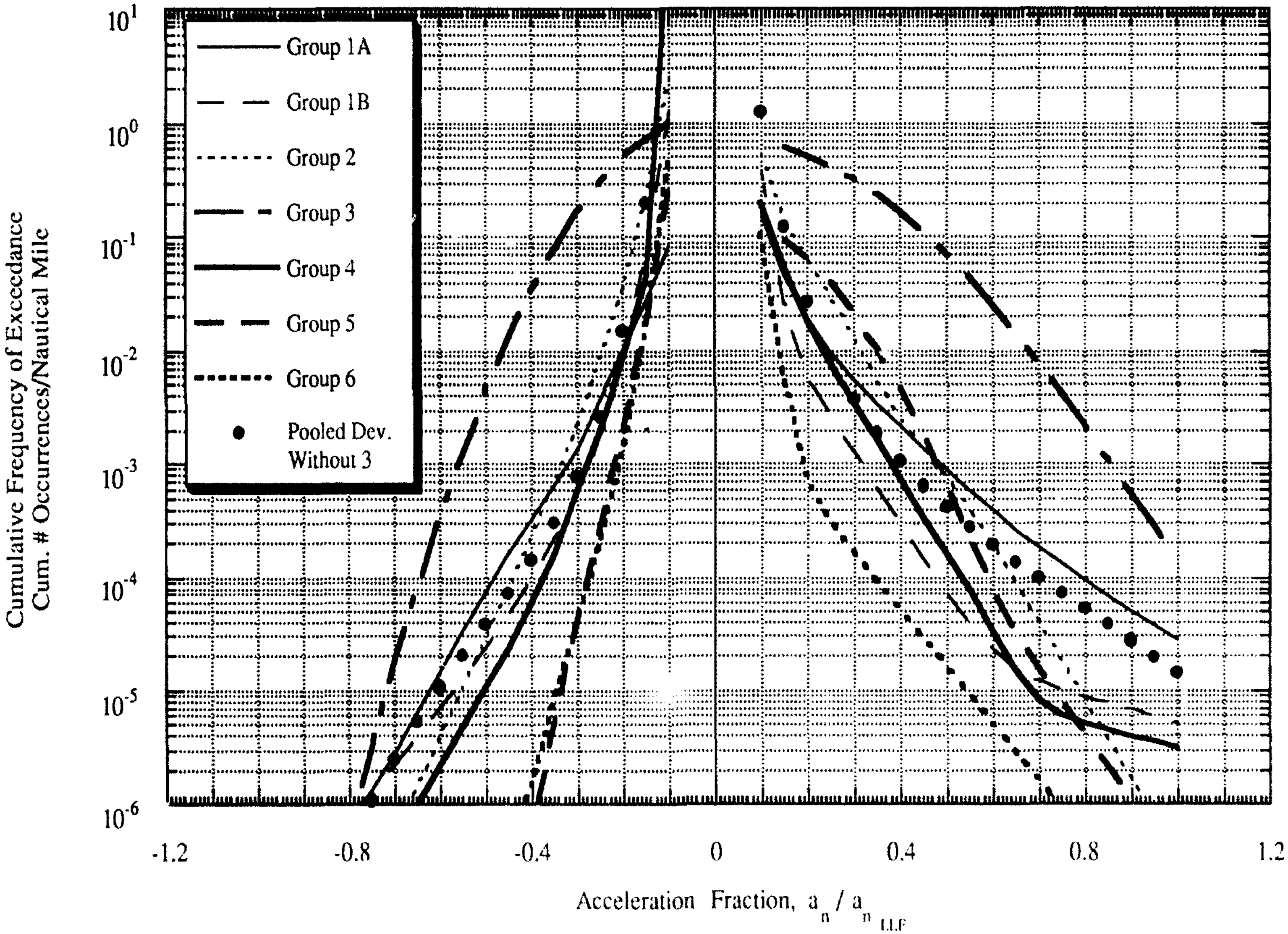


Figure E-13 Gust:Weighted Standard Deviation for Each Group and Pooled

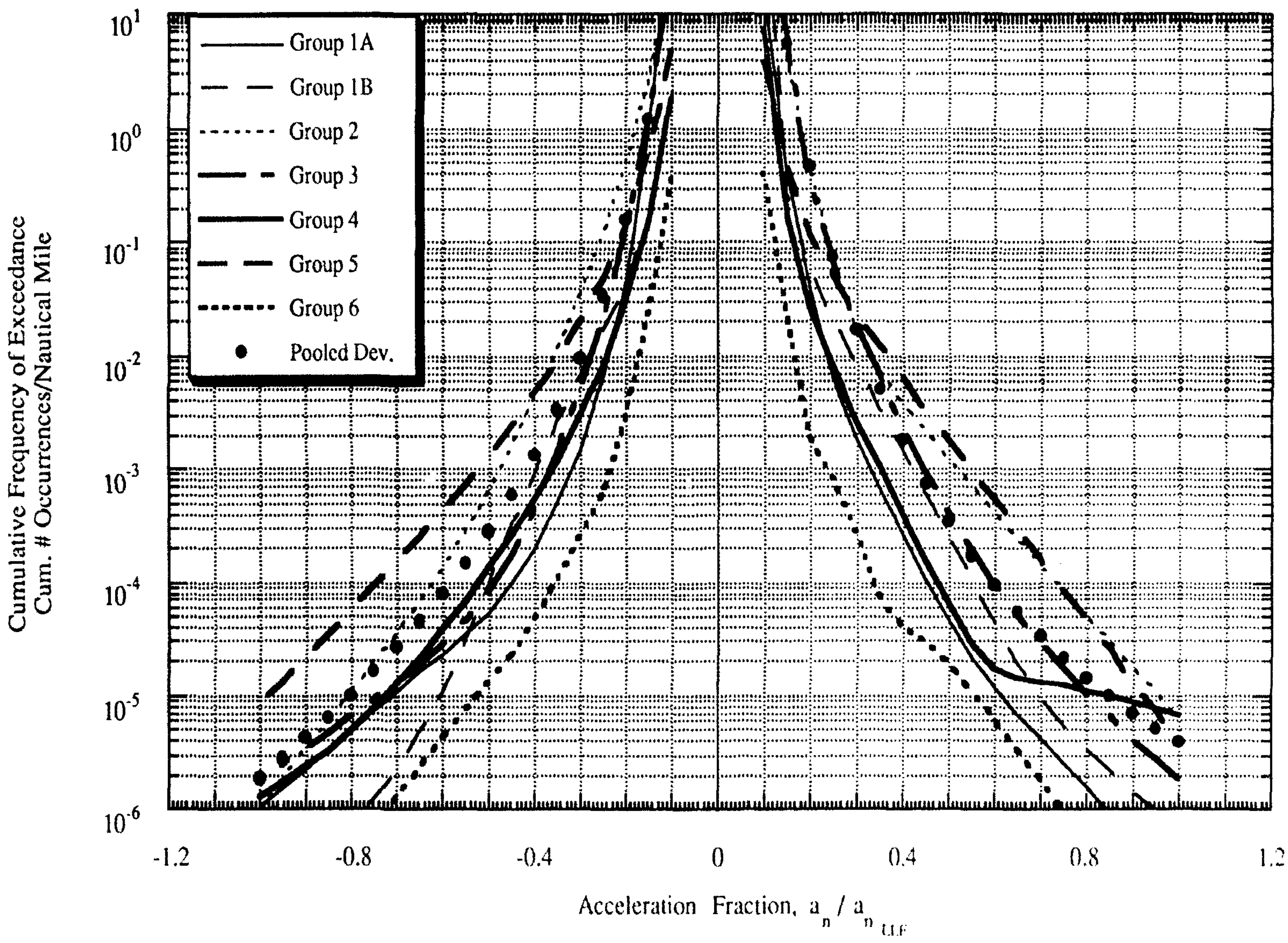


Table E-1 Bartlett Test

a_n/a_{nllf}	Weighted Standard Deviation for Each Group							χ^2
	1a	1b	2	3	4	5	6	
				Negative Gust				
-0.2	0.04443696	0.04286886	0.49252702	0.12917266	0.02945201	0.13845282	0.00289261	13.6504797
-0.4	0.00020163	0.00095492	0.00427132	0.00044666	0.00054182	0.00463331	4.6983E-05	1.67423268
-0.6	2.3638E-05	1.1083E-05	0.00013591	2.8258E-05	3.7678E-05	0.00042908	4.343E-06	0.7723348
# of Airplanes	10	22	4	24	8	3	3	
				Positive Gust				
0.2	0.03660954	0.05592637	0.4353745	0.3338448	0.02568449	0.11499715	0.00184172	31.9612731
0.4	0.00026429	0.00142434	0.00379304	0.00233289	0.00039262	0.00622603	3.9712E-05	2.77435706
0.6	1.1917E-05	4.4423E-05	0.00041272	9.5577E-05	1.6802E-05	0.00052873	6.2096E-06	1.31542724
# of Airplanes	10	24	4	24	8	3	3	
				Negative Maneuver				
-0.2	0.01009697	0.00846136	0.03665082		0.00814813	0.00208498	0.00137881	1.34745217
-0.4	0.0003203	9.7425E-05	0.00023328		5.614E-05	5.7638E-07	1.5349E-06	1.8872805
-0.6	1.4653E-05	7.247E-06	4.1089E-06		2.1911E-06	2.3127E-09	1.1519E-07	1.6576399
# of Airplanes	10	20	4		8	3	3	
				Positive Maneuver				
0.2	0.01927719	0.00584594	0.06146218		0.01823486	0.06483841	0.00070098	3.81642967
0.4	0.00208466	0.00030037	0.00246623		0.00072543	0.00449186	5.0933E-05	1.68421639
0.6	0.000388	2.299E-05	0.00019483		3.3718E-05	7.8603E-05	5.2163E-06	1.28566362
# of Airplanes	10	22	4		8	3	3	

Discussion

This appendix contains a detailed examination of the distribution of the data. As mentioned in Section 2.5, all of the load spectra are based on the assumption that the data is from a normal population. To examine whether this assumption is valid, all of the airplanes used for the statistical analysis are included in one group, and histograms for the cumulative frequency of exceedance distribution are generated by passing a vertical cut through all of the airplane curve fits at a given acceleration fraction. The rationale of pooling the group variances is also examined using Bartlett's Test of Variance Homogeneity (Reference 16).

For each loading condition (positive gust, negative gust, positive maneuver, and negative maneuver), histograms for the cumulative frequency of exceedance distribution are generated at acceleration fractions of $\pm 0.2, \pm 0.4, \pm 0.6$. The resulting distributions are shown in Figs. E-1 through E-10. As demonstrated, the cumulative frequency of exceedance (at a given acceleration fraction) does not follow a normal distribution on a linear scale. But on a logarithmic scale, the cumulative frequency of exceedance distribution appears to be reasonably normal for a large portion of the data, especially for lower acceleration fractions. As would be expected, gust load distributions are more normal than maneuver load distributions, especially when group 3 (Aerial Application) is included in the maneuver distributions. Comparing Figs. E-6 and E-8 with Figs. E-9 and E-10, the maneuver distributions are generally more normal when the Aerial Application group is not included. This would be expected since the Aerial Application maneuver loads are substantially higher than maneuver loads for the other groups.

As mentioned in Section 2.5 and Appendix D, using a pooled standard deviation minimizes the large uncertainties (and scatter) associated with small sample sizes (e.g., groups 5 and 6 - three airplanes, group 2 - four airplanes) and results in more consistent estimates for the 90/95% spectra. In order to use the technique of pooling the group standard deviations, it must first be shown that all of the groups can reasonably be assumed to come from the same population. Based on the logarithmic histograms, the assumption that all of the groups (with the exception of Aerial Application, maneuver) are from a similar population seems reasonable. To examine the validity of this assumption, the group weighted standard deviations S_{wi} and the pooled standard deviation S_p were plotted (Figs. E-11 through E-13). These figures further confirm (at least intuitively) the validity of pooling the standard deviations. Another way to examine the validity of pooling is to employ Bartlett's Test of Variance Homogeneity:

$$M = \left(\sum \nu_i\right) \ln s^2 - \sum \nu_i \ln s_i^2 \qquad s^2 = \frac{\sum \nu_i s_i^2}{\sum \nu_i}$$

$$C = 1 + \frac{1}{3(a-1)} \left(\sum \frac{1}{\nu_i} - \frac{1}{\sum \nu_i} \right) \qquad \text{(EQ 1)}$$

$$\chi^2 = M/C \quad \text{with} \quad (a-1)\text{df}$$

where $\nu_i = n_i - 1$ with n_i being the number of airplanes in group i, a is the total number of groups, and for a logarithmic scale $s_i = \log S_{wi}$, where S_{wi} is the weighted standard deviation for group i.

For each loading condition (positive gust, negative gust, positive maneuver, and negative maneuver), Bartlett's test was performed at acceleration fractions of $\pm0.2, \pm0.4, \pm0.6$. For gust loads all of the operational usage groups were combined ($a = 7$), and for maneuver loads the Aerial Application group was excluded ($a = 6$). The resulting χ^2-values are given in Table E-1. At the 5% level, critical χ^2-values for 5 and 6 degrees of freedom are 11.07 and 12.59, respectively. Corresponding 1% χ^2-values are 15.09 and 16.81. With the exception of the gust results at acceleration fractions of ±0.2, all of the results are acceptable at the 5% level. The -0.2 acceleration fraction gust results are acceptable at the 1% level. Thus, it seems reasonable to pool the variances.

APPENDIX F:

INSTRUMENTATION

DATA PRECISION

READING VGH OSCILLOGRAMS

DATA PROCESSING

NOTE: Sections 1 and 2 of this Appendix were e cerpted or adapted from References 2 and 4.

1 Instrumentation

Data were obtained from NASA VGH recorders described in Reference 17, Briefly, these instruments record (on a time-history basis) the indicated airspeed of the airplane, pressure altitude based on standard atmospheric conditions, and normal acceleration measured near the airplane center of gravity. The accelerometer was rigidly mounted within the airplane center of gravity range. The recorder has three main components: a base containing the recording elements, a drum containing the recording paper, and a remote accelerometer. The recording base with the drum attached occupies a space about 8 in. high by 6 in. wide by 12 in. long. Their combined weight is 17 lb. The remote accelerometer is about 2 in. high by 2 in. wide by 7 in. long and weighs 2 1/4 lb. A photograph of the recorder is shown in Figure F-1.

Recorders used in the NASA VGH General Aviation Program were selected for a particular installation according to the airspeed capabilities of the airplane to be instrumented. These airplanes were instrumented with a 0 to 240 knot recorder, a 0 to 350 knot recorder, or a 0 to 460 knot recorder. All recorders used the same altitude range (-1000 ft up to infinity), and all except the aerobatic installation (6g to -3g) used the same acceleration range (4g to -2g).

2 Data Precision

The reliability of the data is affected by instrument error, installation error, and reading error. Total overall errors for the VGH recorder are discussed in section I of Reference 18 and are estimated to be

a. Acceleration, g units: ±.05

b. Airspeed Error

Flight regime	Airspeed interval (with corresponding maximum error), knots	Recorder
Takeoff/landing Cruise High speed	40 (±5.0) to 80 (±2.0) 80 (±2.0) to 180 (±1.0) 180 (±1.0) to 240 (±1.0)	0 to 240 knots
Takeoff/landing Cruise High speed	60 (±7.0) to 120 (±3.0) 120 (±3.0) to 200 (±2.0) 200 (±2.0) to 350 (±1.0)	0 to 350 knots
Takeoff/landing Cruise High speed	100 (±7.0) to 150 (±4.0) 150 (±4.0) to 320 (±2.0) 320 (±2.0) to 450 (±1.0)	0 to 460 knots

c. Altitude Error

Pressure altitude, ft.	Maximum error, ft.
0	±160
5000	±185
10000	±205
15000	±240
20000	±275
25000	±320
30000	±385

d. Reading Errors

Reading errors are believed to be small in terms of magnitudes of the particular quantities read, inasmuch as each tabulation has been checked and corrected for gross errors. The reading errors for acceleration, although small, may affect the count of accelerations exceeding given values. Reading checks have indicated that for individual records, the number of acceleration counts may have a reliability of about ±30 percent, except for the extreme values, which were individually verified by detailed review of the time histories. Therefore, it is believed that the reliability of the frequency of occurrence of the extreme values is much better than ±30 percent. Since reading errors tend to balance out as the

sample size increases, the value of cumulative frequency per mile for the overall distributions of gust and maneuver accelerations and of derived gust velocities are estimated to be within ±20 percent.

3 Reading VGH Oscillograms

Approximately 7,000 hours of oscillogram data was read by the University of Kansas Center for Research (KU-CRINC) under contract to the FAA Small Airplane Certification Directorate during the time period September 1984 to August 1986. The rules and procedures for reading oscillograms were defined by FAA in consultation with NASA personnel who managed the previous task of reading the 35,286 hours of data reported in Reference 2. These instructions for reading oscillograms are contained in Reference 19.

Figure F-2 shows sample VGH records as reproduced from Reference 4. Each acceleration reading was identified on the oscillograms as gust or maneuver. This was done by visual inspection, gusts normally being high frequency spikes that are narrow in width and closed at the bottom. In cases where it was difficult to distinguish a gust acceleration from a maneuver acceleration, the airspeed and altitude traces were studied to assist in this determination. Gust trace deflections were of two types as follows:

1. Gust response that occurs when the airplane is <u>initially</u> at a 1.0 g condition. These trace deflections were measured from the 1.0 g line.

2. Gust response that occurs while the airplane is undergoing a maneuver acceleration. These trace deflections were measured from the maneuver trace on which they occur (not from the 1.0 g line).

Maneuver trace deflections were of two types as follows:

1. Maneuver accelerations that originate from a 1.0 g condition.

2. Maneuver accelerations that do not originate from a 1.0 g condition or do not return to the 1.0 g condition.

Both types were measured from the 1.0 g line, however, only the largest of a <u>group</u> of maneuver trace deflections were reported, i.e., a group of deflections that did not return to the 1.0 g line.

NOTE: A group of maneuver accelerations are those that occur between the time the trace departs from the 1.0 g line and returns to the 1.0 g line. Only the largest of these were reported (provided, of course, that it exceeded the threshold value).

The threshold value for reading gust or maneuver accelerations was ±0.4g for the data read by KU-CRINC. Some of the data read by NASA used a lesser threshold value of ±0.3g or ±0.2g as discussed in Section 2.3 of this report.

Airspeed and altitude trace deflections were read at every minute (time) mark, and also were read when the normal acceleration trace was read. A digitizing tablet and cursor was employed to record all readings directly in the computer used for data processing.

Landing impacts were not recorded.

Considerable effort was expended on quality control to ensure that the data read from the oscillograms was accurate. The quality control procedures are described in Reference 10, 11, 12, and 19. Every fifth flight was checked for quality. For a typical 30-minute flight, not less than 10 sets of points were checked for accuracy. A set included one point from each trace (altitude, velocity, and acceleration) at the same X-coordinate. If a discrepancy was found, the flight was reread. If one check on a roll failed (e.g. flight 5) and the next check also failed (flight 10), the flights between those two check flights were analyzed. This process was repeated as required until all flights were satisfactory. If two or three such failure events occurred on a given oscillogram, the entire roll was reread.

4 Data Processing

Data processing procedures, quality control procedures, equipment list, calibration charts and computer program listings are contained in References 10, 11, and 12.

Figure F-1:

NASA VGH recorder.

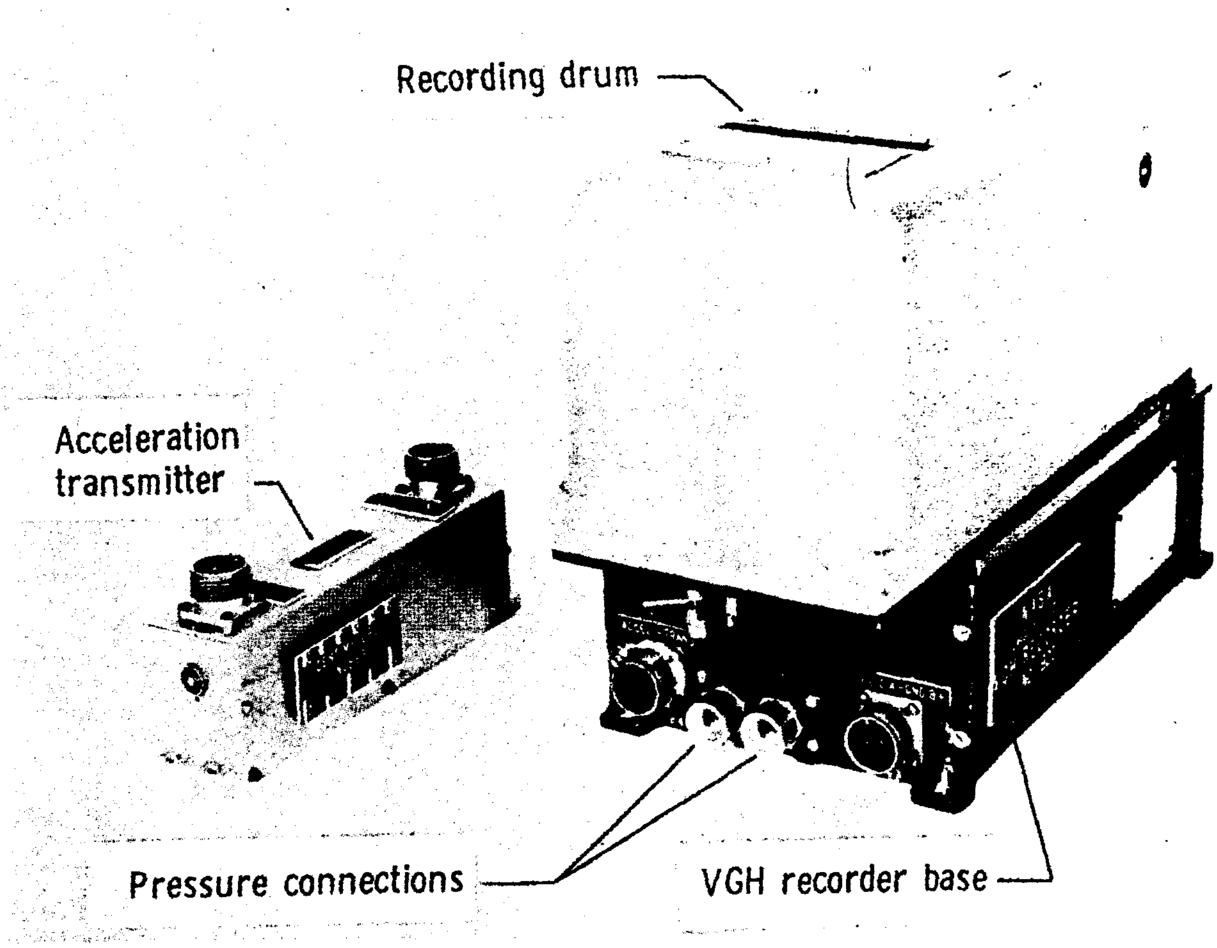
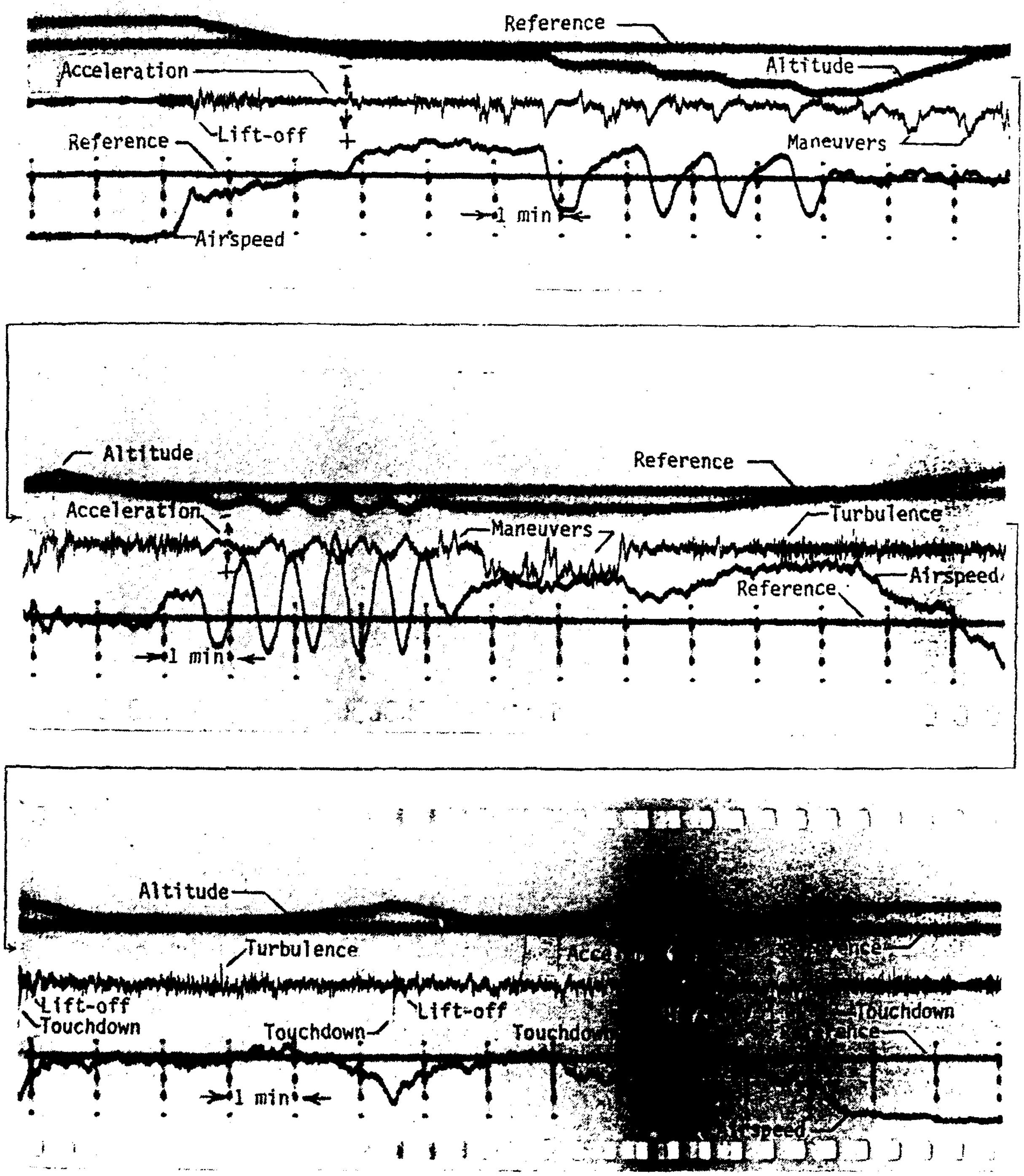


Figure F-2:

Sample VGH record from flight performed in instructional operations.



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